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FORT DIX REMEDIAL INVESTIGATION/ FEASIBILITY STUDY FOR MAG-1 AREA

FINAL HEALTH AND SAFETY PLAN DATA ITEM A008

CONTRACT NO. DAAA15-91-D-0008 TASK ORDER 0007

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

JANUARY 1994

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
FORT DIX U.S. ARMY INSTALLATION
FORT DIX, NEW JERSEY

MAG-1 AREA
FINAL HEALTH AND SAFETY PLAN
DATA ITEM A008

CONTRACT NO. DAAA15-91-D-0008
TASK ORDER 0007

Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

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Project No. 7134-03

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FORT DIX RI/FS MAG-1 AREA

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1.0 GENERAL

1.1 SCOPE AND PURPOSE

This Health and Safety Plan (HASP) was prepared by ABB Environmental Services, Inc. (ABB-ES) in response to Task Order 0007 of Contract DAAA15-91-D-0008 for the Remedial Investigation/Feasibility Study (RI/FS) at the Magazine Area 1 (MAG-1) Area of the Fort Dix U.S. Army Installation (Ft. Dix), New Jersey. The HASP addresses all activities associated with the RI/FS field operations at MAG-1 and has been prepared in conformance with the ABB-ES Health and Safety Program and is intended to meet the requirements found in 29 CFR 1910.120. Compliance with the HASP is required of all ABB-ES personnel, contractor personnel, or third parties entering the site.

This site-specific HASP has been prepared to address foreseeable hazards associated with field activities during the RI/FS at the MAG-1 Area at Ft. Dix. The HASP includes a description of ABB-ES' Health and Safety Program, specific site activities to be performed, potential hazardous substances and conditions, procedures to avoid or control hazardous situations, and procedures to monitor compliance with ABB-ES' Health and Safety Program.

The identified hazards, the levels of personal protective equipment, and the procedures detailed in this HASP are the minimum health and safety requirements to be observed by all site personnel. *Ft. Dix "Contractor/Subcontractor Rules and Guidelines for Security/Fire Protection"* must be adhered to by all personnel entering Ft. Dix, and are included in Appendix A of this HASP. Any proposed changes/ amendments to this HASP must be reviewed by the Project Health and Safety Manager (HSM) and the U.S. Army Environmental Center (USAEC) Safety and Environmental Services branch prior to implementation. The Health and Safety Plan Revision Form, Appendix B, will be used to facilitate changes identified during field work.

A copy of the Final Health and Safety Plan must be provided to the USAEC Safety and Environmental Services Branch. Field work shall not commence on this project until comments have been incorporated and the final plan approved by this Branch.

1.2 REQUIRED TRAINING

Training, as defined under the ABB-ES Health and Safety Program, Section 3.0, and meeting the requirements of 29 CFR 1910.120, is required for all personnel entering potentially contaminated areas of this site. This training includes 40 hours of initial training, three days of on-the-job training, an 8-hour annual refresher training, site-specific training, and, if acting in an on-site supervisory capacity, 8 hours of supervisory safety training. Personnel without the required training will not be permitted to enter the exclusion zone.

In addition, training and fit-testing in accordance with OSHAs Respiratory Protection Standard (29 CFR 1910.134) is required for all personnel who are required to wear a respirator or who could potentially be required to upgrade to Level C or B.

All training documentation (1910.120 and 1910.134) must be provided to the HSO prior to allowing an individual to enter the exclusion zone. All training documentation will be maintained at the site at all times.

1.3 HEALTH AND SAFETY PROGRAM

This HASP applies to all site activities associated with the RI/FS at Ft. Dix. Site activities will be performed in compliance with this HASP. All site personnel, including ABB-ES personnel, contractor personnel, or third parties entering the site will be required to comply at a minimum with this site-specific HASP. A copy of the site-specific HASP will be available to all site personnel. All site operations personnel and visitors including government employees or representatives will be required to sign the Health and Safety Plan Signature Sheet, indicating knowledge of, and understanding of, the HASP, in addition to the medical data sheet (Appendix C). All agencies and companies involved with the field and laboratory work at Ft. Dix will be responsible for the health and safety of their own employees. Health and Safety is the individual responsibility of each person assigned to a field project.

The following briefly describes the health and safety designations and general responsibilities which will be employed for the Ft. Dix RI/FS project.

1.3.1 Health and Safety Manager

ABB-ES' HSM, Ms. Cindy Sundquist, may be reached at (207) 775-5401, extension 3601 in Portland, Maine. The HSM has final authority to resolve health and safety

issues that are not resolved at the site or through the Health and Safety Supervisor (HSS), and has overall responsibility for ensuring that the policies and procedures of this HASP are implemented by the Health and Safety Officer (HSO).

The HSM is responsible for ensuring that the health and safety program for this project is established and administered in compliance with federal, state, and contract-specific requirements as well as generally accepted professional practices.

1.3.2 Health and Safety Supervisor

The HSS for ABB-ES, Meg MacLeod, may be reached at (207) 775-5401, extension 3606, in Portland, Maine. The HSS will be responsible for (1) approval of the individual chosen to serve as the site HSO for this field operation; (2) review and approval of site-specific HASPs developed by the HSO, as well as any significant changes made over time to the site HASP; (3) oversight of the daily efforts of the HSO; (4) resolution of site disputes involving health and safety issues; and (5) implementation of the HASP by the HSO. The HSS will notify the HSM of any stop work orders issued by an HSO.

1.3.3 Health and Safety Officer

The HSO for the Ft. Dix Remedial Investigation (RI) project, Paul Bolmer has been approved by the ABB-ES HSS. The HSO has the responsibility to develop and implement this site-specific HASP in accordance with the ABB-ES Health and Safety Program. The HSO will conduct safety inspections and investigate all accidents, illnesses, and incidents occurring on this site. The HSO will also conduct safety briefings and site-specific training for on-site personnel. As necessary, the HSO will accompany all U.S. Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA), or other governmental agency personnel visiting the site in response to health and safety issues. The HSO, in consultation with the HSS, is responsible for updating and modifying this HASP as site or environmental conditions change.

The HSO is vested with the authority to stop site operations (STOP WORK AUTHORITY) if he determines that an imminent health or safety hazard or other potentially dangerous situation exists. Some situations that could lead to the issuance of a stop work order include:

- An unauthorized individual entering the exclusion zone.

- The identification of a serious OSHA violation (e.g., an individual entering an unshored, unsloped, excavation).

- The identification of an imminent safety hazard (e.g., a suspended load about to fall or stress cracks around an excavation indicating a potential cave in).

- Discovery of a chemical hazard outside the scope of the HASP and/or the PPE and monitoring equipment available at the site.

The HSO is to immediately notify the HSS and the USAEC Contracting Officer's Representative (COR) and Safety and Environmental Services Branch of any Stop Work Orders issued. The HSO may also recommend to the HSS or HSM that the downrange authorization of individual site personnel be revoked for health and/or safety causes.

The HSO, through the HSS, assures that all personnel entering the Ft. Dix site are qualified for downrange deployment in accordance with the ABB-ES Health and Safety Program requirements. The HSO may designate an HSO designee to assist in the health and safety activities at the site.

1.4 Medical Surveillance

All personnel entering potentially contaminated areas of this site must be medically qualified for the site assignment as determined by a medical surveillance program, such as that outlined in the ABB-ES Health and Safety Program, Section 3.0. Personnel who have not received medical clearance will not be permitted to work in a downrange position.

Medical Clearance documentation must be provided to the HSO prior to allowing an individual to work downrange. Medical Clearance records will be maintained on-site at all times.

1.5 Coordination of Field and Installation Safety Activities

All contractors will be required to coordinate with the following installation facilities prior to starting field activities:

- Emergency medical facilities - for emergency support

- Environmental office - for environmental support
- Safety office - for installation safety and security requirements and support, and
- Fire department - contractors must furnish the fire department with a list of all chemicals (to include quantities and storage location) brought on the installation (i.e., preservatives, calibration gases, etc).

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2.0 SITE CHARACTERIZATION AND ANALYSIS

2.1 SITE NAME, LOCATION, AND SIZE

Ft. Dix, consisting of 31,110 acres, is located in Burlington and Ocean Counties, New Jersey, approximately 20 miles southeast of Trenton (Figure 2-1). The primary activities at the Fort have been as a cantonment, training post, and demobilization center since 1917, and is currently an active training center. Investigative activities will be performed at the MAG-1 Area, described in Section 2.5.

2.2 SCOPE OF WORK

Field investigations to be performed by ABB-ES will be designed to characterize soil, surface water, sediment, and groundwater conditions at the site. Based on site conditions described in the Technical Plan, tasks may include, but not be limited to, the following elements:

- geophysical survey
- test pit excavations
- soil borings
- monitoring well installations
- soil and groundwater sampling
- surface water and sediment sampling
- water level measurements and aquifer tests

2.3 SITE HISTORY

Ft. Dix, initially called Camp Dix, was established on July 18, 1917, as a cantonment area and training post for World War I troops. After the war, the camp served as a demobilization center, and from 1922 to 1926 it was used as a training ground for active Army, Army Reserve, and National Guard units. The camp was inactive from 1926 to 1933, but from 1933 to 1939 it served as a reception, discharge, and replacement center for the Civilian Conservation Corps. In 1939, the camp became a permanent Army installation, and its name was changed to Ft. Dix. The installation again served as a reception and training center during World War II, and after the war it was used as a separation center. In 1947, Ft. Dix was designated as a basic training center and is currently used for that purpose. In 1956, the post was officially designated the U.S. Army Training Center and Ft. Dix.

Ft. Dix is now a government-owned installation under the jurisdiction of the U.S. Army Training and Doctrine Command (TRADOC). Its mission is to conduct Basic Combat Training and Advanced Individual Training, and to provide Combat Support and support to Reserve and National Guard Units.

2.4 HAZARDOUS SUBSTANCES/CONDITIONS

The overall hazard level at Ft. Dix is anticipated to be low. General health hazards, safety hazards, and explosive and fire hazards associated with investigations at Ft. Dix are presented in the following sections.

The following table summarizes the task-specific hazards.

SITE HAZARDS	GPR	TEST PITS	BORING	MON. WELLS	SW/SD SAMPLING	WATER LEVEL
Contaminants	X	X	X	X	X	X
Heavy Equipment		X	X	X		
Underground Utilities		X	X	X		
Explosives		X	X	X		
Snake and Insect Bites	X	X	X	X	X	X
Lyme Disease	X	X	X	X	X	X
Ft. Dix Activities	X	X	X	X	X	X
Deer Hunting	X	X	X	X	X	X
Cold Stress	X	X	X	X	X	X
Uneven Terrain	X	X	X	X	X	X

2.4.1 Hazard Communication

In 1986, OSHA began enforcing the Hazard Communication Standard (HCS) (29 CFR 1910.1200). This standard requires employers to make their associates aware of the hazards to which they may be exposed. This standard does not apply to exposures to hazardous waste. Therefore, on hazardous waste sites, the only chemicals covered by the HCS are those that ABB-ES or its subcontractors bring onto the site, such as decontamination fluids and sample preservation chemicals. In 1987 when the Hazardous Waste Operations and Emergency Response Standard (29

CFR 1910.120) was first promulgated, most of the components of the HCS were incorporated into the new standard. Because of this, the only components of the HCS that need be addressed separately at a hazardous waste site are labeling and MSDSs. The rest of the standard has been included in 1910.120 or is part of the overall ABB-ES Health and Safety Program.

MSDSs for all chemicals brought to the site will be added to the MSDS section of the Health and Safety Plan and will be reviewed by all employees and subcontractors working at the site.

ABB-ES' policy has been to minimize chemical storage by purchasing small sized containers that are shipped directly to the site, so as to avoid the need to transfer bulk chemicals to smaller containers (Note: The sample jars have been purchased with the preservative already added). The original label will be kept on all containers. If the chemical needs to be transferred to a smaller container, the new container will be labeled with the name of the contents and appropriate hazard warnings (e.g., any combination of words, pictures, or symbols that conveys the chemical hazard; for example, the word "flammable" with a picture of a flame) if required.

Note: If the chemical has been transferred to a secondary container that is to be used that day by the person doing the transferring (e.g., TSP added to water for decontamination or methyl alcohol added to a squeeze bottle), labeling is not required. Some labeling may be used to distinguish a container's contents if similar containers are used (e.g., "methyl alcohol" or "alcohol" written on the squeeze bottle to distinguish its contents from DI water).

ABB-ES personnel and subcontractors will not store more than 10 gallons of flammable/combustible chemicals on site at one time. If larger quantities are needed then ABB-ES will be required to obtain a flammable storage cabinet for the chemicals. In addition, ABB-ES will:

- store only compatible chemicals together,
- store calibration gases and chemicals in an area where there is limited traffic,
- provide material safety Data Sheets on site for these and any other compounds brought to the site, and

- maintain compounds in their original containers (properly labeled) until used.

2.5 MAG-1 AREA

The MAG-1 Area is currently used as a transfer area for refuse generated at Ft. Dix. The MAG-1 Area is located in the northwestern portion of the Cantonment Area (see Figure 2-2).

Previously, the MAG-1 Area was the site of an ammunition and weapons magazine storage area and vapor degreasing operation, where cosmoline was removed from rifles between 1942 and 1965. Cosmoline, a vaseline-type petroleum product used for packing rifles during shipment, was removed using trichloroethene (TRCLE). The TRCLE/cosmoline mixture is reported to have been discarded in depressions in a rubble pile located behind (south of) the storage building.

2.5.1 Scope of Work

Screened Auger Borings. Up to 18 screened auger soil borings will be advanced at this site.

Monitoring Wells. Up to 13 monitoring wells and 6 piezometers will be installed and developed at this site.

GPR Survey. Up to 1.6 acres will be surveyed with Ground Penetrating Radar (GPR) at this site.

Soil Borings. Up to 11 soil borings with subsurface soil sampling will be advanced at this site.

Test Pits. Three test pits will be excavated during the field investigation at this site.

Surface Water/Sediment Sampling. Up to 15 surface water/sediment samples will be collected in streams and wetlands near the site.

Groundwater Sampling. One round of groundwater sampling will be conducted at the site.

Aquifer Testing. Up to 12 monitoring wells will be slug tested and 2 of these wells will be utilized for constant discharge aquifer testing.

2.5.2 Hazardous Substances and Conditions

Previous investigations performed at the site have identified the contaminants listed in Table 2-1 at this site. The site contaminants of concern, based on health and safety issues are benzene (C6H6), carbon disulfide (CS2), lead (PB), explosives residuals, and TRCLE.

2.5.3 Initial Site Entry

2.5.3.1 Initial Level of Protection. Information regarding the levels of protection that will be employed during this field investigation are listed below.

- GPR survey - Level D
- Test pit excavation and sampling - Modified Level D
- Boring and subsurface soil sampling - Modified Level D
- Monitoring well installation and sampling - Modified Level D
- Surface water/sediment sampling - Modified Level D
- Water level measurement and aquifer testing - Level D

Should site conditions warrant an upgrade in the level of protection from modified Level D, ABB-ES will discontinue work until the situation has been reevaluated by ABB-ES and USAEC.

2.5.3.2 Initial Monitoring. A photoionization detector (PID), Draeger Tubes, and a particulate monitor will be used to monitor the breathing zone. A lower explosive limit/oxygen meter (LEL/O_2) will be used to monitor the source (LEL) and breathing zone (0_2) during soil boring and well installation. Although radioactive contamination is not anticipated, a Radiation Alert Monitor 4 will be used to monitor each area for gross radiation during field investigations. If radioactive contamination is not found, future monitoring can be discontinued.

2.5.3.3 Operation Levels of Protection. If the PID meter reads steadily above background the radiation meter reads twice background, or the particulate monitor indicates air born dusts/mists above 2.5 milligrams per cubic meter (mg/m^3) the following action levels shall be used to determine the need for action on the part of field personnel (i.e., upgrade of personal protective equipment [PPE], or site evacuation). Engineering controls should be considered where possible (where there is a point source only), and their implementation must be approved by the HSS or the HSM.

Radiation Alert Monitor 4

If the radiation meter indicates readings two times the background levels immediately evacuate the site and contact the HSO.

PID Meter Action Levels

PID > Background	Draeger Tube for benzene and carbon disulfide
PID > 22 ppm (parts per million)	Upgrade to Level C PPE
PID > 50 ppm	Upgrade to Level B PPE.

Draeger Tube Action Levels

Benzene (5/c) > 0.5 ppm	Upgrade to Level C PPE
Carbon Disulfide (0.04) > 2.0 ppm	Upgrade to Level C PPE

NOTE: Draeger Tubes are not always compound specific.

Particulate Monitor

Greater than 2.5 mg/m^3	Attempt dust suppression methods (e.g., spray area with water) if methods are unsuccessful, upgrade to Level C and monitor perimeter of Exclusion Zone. If elevated readings are detected, stop work and re-establish zones.

Combination Meter (LEL/O_2)

LEL	≥	10%	Stop all electrical or spark producing activities
LEL	≥	20%	Stop all work and contact the HSO
O_2	≤	19.5%	Stop all work and contact the HSO

2.5.4 Site Risks

General health hazards or safety hazards associated with investigation and sampling activities at the site are presented in this section.

2.5.4.1 Health Hazards. The potential health hazards associated with the site include inhalation, ingestion, and dermal contact of explosives residuals; organic and inorganic chemicals that may be present in site soils and waters. Special care should be taken to avoid contact with contaminated soils as some of the contaminants of concern have PELs/TLVs with skin notations. The Chemical Hazard Response Information System (CHRIS) data sheets (or their equivalent) for compounds identified at the site, decontamination chemicals, and sampling preservatives are provided in Appendix D. During warm months (spring through early fall), tick-borne Lyme Disease is endemic to the Ft. Dix area. An information sheet on Lyme Disease is included in Appendix E.

2.5.4.2 Safety Hazards. Physical safety hazards at the site include (1) underground utilities, (2) explosives, (3) snakes and biting insects, and (4) Ft. Dix work activities (i.e., tanks, artillery, etc.). Deer hunting using firearms and bow and arrow is permitted at Ft. Dix and presents a potential safety hazard during hunting season. If work is being done during the hunting season where hunters are likely to be, workers will wear blaze orange unless already wearing brightly colored tyveks. Normal safety procedures will be followed while working around heavy equipment. Normal Safety Procedures include the following:

1. All unnecessary personnel should stand well clear of heavy equipment, especially when setting up or in operation. Workers should also note the radius of movement of equipment and avoid working within this area.

2. Workers shall not stand under suspended loads nor under the backhoe bucket, as the load or hydraulics can accidentally give way.

3. Workers shall not ride the bucket into or out of excavations, or stand or sit on the outside of equipment while in motion.

4. Only one operator in the cab at a time while equipment is in operation.

5. Avoid standing on the downhill side of a piece of heavy equipment.

Care should be taken to avoid contact with any surface water at the site. Potential difficulties include uneven terrain, difficulty in entry of personnel and equipment, and

aggravation of terrain problems due to weather conditions (i.e., rain, ice, and snow). All operations must be conducted under good lighting conditions.

2.5.4.3 Explosive and Fire Hazards. Explosive compounds have not been detected in soils and sediments at the MAG-1 Area. However, the potential presence of dinitrotoluene (DNTs) (possibly trinitrotoluene [TNT], cyclonite [RDX], and cyclotetramethylenetetranitramine [HMX]) in the soils and sediments at MAG-1 should not be overlooked. The form of these chemicals can mitigate their explosive properties and even the temperature at which they burn. According to the U.S. Environmental Protection Agency-approved Bureau of Mines reactivity tests for detonation and internal ignition, soils containing up to 30,000 micrograms per gram of explosives were tested and were not reactive. At the MAG-1 Area, pure explosives have not been detected in soils and sediments, and are not expected.

As a precaution, if any compound is found in crystalline or liquid form, stop work. Special care must be taken to avoid friction, high temperatures, and shock. Because of the potential for fire and even explosion, and because of the nature of an Army training facility at which explosives are tested and stored, smoking and carrying matches, lighters, or any other flame- or spark-producing device is prohibited within the MAG-1 Area. Similarly, ammunition, explosives, and firearms may not be brought onto Ft. Dix without special authorization.

2.5.4.4 Specific Site Risks. In general, the terrain presents no hazards at this site. The exception to this is the rubble pile. During drilling and sampling tasks at the site, vapors from the VOCs may become concentrated within the exclusion zone. Engineering controls should be considered for removal of these vapors from the exclusion zone, however potential downwind receptors must be considered. Precautions should be taken during drilling activities due to high power electrical lines present at the site.

3.0 SITE CONTROL

3.1 ZONATION

Each site will normally be divided into three zones. The working area of each site will be considered the Exclusion Zone, with limited areas serving as the Support Zone and an area for decontamination called the Contamination Reduction Zone (CRZ). The Support Zone and CRZ around each working area will be defined in the field. Definitions of allowable activities in each zone are presented in the following subsections.

3.1.1 Exclusion Zone

The intent of the Exclusion Zone is to isolate the area of contaminant generation, and to restrict to the extent possible the spread of contamination from active areas of the site to support areas and off-site locations. The Exclusion Zone is demarcated from the remainder of the site by the Hot Line, which will be a tape line. Personnel entering into the Exclusion Zone must: enter through the CRZ; be wearing the prescribed level of protection (see Section 4.3.1); and been found otherwise authorized to enter the Exclusion Zone (see Sections 1.3, 1.4, and 10.1). Personnel, equipment, or materials exiting the Exclusion Zone will be considered contaminated; personnel will be decontaminated and equipment and materials will be decontaminated or containerized in uncontaminated devices.

Within the overall Exclusion Zone, specific locations or restricted areas, clearly marked or identified, will be established as necessary for particular locations or around specific site operations. In the case of well drilling or excavation operations, a restricted area will be established that includes a minimum 30-foot radius from the drill rig or excavation operation.

3.1.2 Contamination Reduction Zone

Moving out from the Exclusion Zone, starting at the Hot Line and continuing to the Contamination Control Line, is the CRZ. The concept of the CRZ is that of a transition zone between contaminated and uncontaminated areas of the site. As such, when contaminated personnel, equipment, or materials cross the Hot Line they are assumed to be contaminated from site operations. Then, by being subjected to decontamination processes, they become less contaminated so that when they reach

the Contamination Control Line they are clean and can exit this zone without spreading contamination.

A Contamination Reduction Corridor (CRC), which includes materials necessary for full personnel and portable equipment decontamination, will be located within the CRZ. A separate facility will be established for heavy equipment decontamination needs. In addition, safety equipment (e.g., emergency eye wash, fire extinguisher, stretcher, and first aid kit) will be staged in this zone.

3.1.3 Support Zone

The Support Zone (i.e., the outermost zone of the site) is separated from the CRZ by the Contamination Control Line and is considered a clean area. Movement of personnel and materials from this zone into the CRZ is generally unrestricted except as required through access points controlled for administrative purposes. However, only uncontaminated/decontaminated personnel or materials may enter this zone from the CRZ.

The Support Zone will contain the necessary support facilities (including personal hygiene facilities) for site operations and will serve as the communications center and source of emergency assistance to operations occurring in the exclusion zone and CRZ. A log of all persons entering the site will be maintained by the HSO, the Site Operations Leader (SOL), or site designee.

3.2 MEDICAL ASSISTANCE

The primary source of medical assistance for Ft. Dix is the Memorial Hospital of Burlington County in Mt. Holly, New Jersey. The alternate source of medical assistance is the Kimball Medical Center in Lakewood, New Jersey. Walson Army Community Hospital, located on the base, does not offer emergency services. However, the base does offer professional ambulance service to the Memorial Hospital of Burlington County for emergency situations. Both the on-site hospital and the Fire Department will be contacted in the event medical assistance is necessary.

A list of emergency telephone numbers for the Ft. Dix site is presented in Section 7.0 and Appendix F. Directions to the two hospitals are presented in Appendix G. The telephone numbers and addresses for the hospitals are as follows:

1. Memorial Hospital of Burlington County
   175 Madison Ave.
   Mt. Holly, NJ 08060-2099
   Telephone: 609-267-0700
   Emergency Room Telephone: 609-261-7045

Directions:

From the Ft. Dix St. - Texas Ave. - Wrightstown Rd. traffic circle:

Take Route 545 (Wrightstown-Georgetown Rd.) north. Take a left (towards Mt. Holly) onto Route 537 to Madison Ave. Take a left onto Madison Ave; hospital is on the left. Approximate travel time is 20 to 30 minutes.

2. Kimball Medical Center
   600 River Ave.
   Lakewood, NJ 08701-5281
   Telephone: 908-363-1900

Directions:

From the Ft. Dix St. - Texas Ave. - Wrightstown Rd. traffic circle:

Take Route 545 (Trenton Rd.) south to Route 530 south. Turn left onto Route 70 east. Take a left onto Rt. 9 North (River Ave.) towards Lakewood. Hospital is on the left. Approximate travel time is 30 to 40 minutes.

3.3 FIRE PREVENTION/SAFETY REQUIREMENTS

The Ft. Dix Contractor/Subcontractor Rules and Guidelines for Security/Fire Protection are presented in Appendix A.

3.4 SITE COMMUNICATIONS

Field personnel will maintain communication via the use of cellular telephones and/or portable radios. During work within the exclusion zone, workers shall use hand signals agreed upon prior to entering the exclusion zone.

Emergency Signals

In most cases, field personnel will carry portable radios for communications. If this is the case, a transmission that indicates it is of an emergency nature will take priority over all other transmissions. All other site radios will yield the frequency to the emergency transmissions.

Where radio communication is not available, the following air-horn signals will be used:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(_ _ _)
ALL CLEAR	alternating long and short blasts	(_._.)

4.0 ENGINEERING CONTROLS, WORK PRACTICES, AND PERSONAL PROTECTIVE EQUIPMENT

4.1 ENGINEERING CONTROLS

Engineering controls will be used where appropriate during all field investigations at Ft. Dix.

4.2 WORK PRACTICES

Workers are expected to adhere to established safe work practices for their respective specialties (e.g., drilling, laboratory analysis, or surveying). Work at the site will be conducted according to established protocols and guidelines for the safety and health of all involved. Among the most important of these principles for working at a hazardous waste site are the following:

- In any unknown situation, always assume the worst conditions and plan responses accordingly.

- Use the buddy system. Under no conditions will any person be permitted to enter the Exclusion Zone alone. Establish and maintain communication. In addition to radio communications, it is advisable to develop a set of hand signals, because conditions may greatly impair verbal communications.

- Because no personal protective equipment is 100-percent effective, all personnel must minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures accordingly. Do not place equipment on drums or the ground. Do not sit on drums or other materials. Do not sit or kneel on the ground in the Exclusion Zone or CRZ. Avoid standing in or walking through puddles or stained soil.

- Smoking, eating, or drinking in the work area and before decontamination will not be allowed. Oral ingestion of contaminants is the second most likely means of introducing toxic substances into the body (inhalation is the first).

- Avoid heat and other work stresses related to wearing protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.

- To the extent feasible, handling of contaminated materials should be done remotely, particularly when drummed or other containerized hazardous waste materials are found on-site. Every effort should be made to identify the contents of containers found on-site before they are subject to material-handling applications.

- Personnel must be observant of not only one's own immediate surroundings, but also those of others. Everyone will be working under constraints; therefore, a team effort is needed to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment and while utilizing personal protective gear because vision, hearing, and communication can be restricted.

- Contact lenses are not allowed to be worn on-site; if corrosive or lachrymose substances enter the eyes, proper flushing is impeded.

- All facial hair that interferes with the facepiece fit, must be removed prior to donning a respirator at all sites requiring Level C or B protection.

- Rigorous contingency planning and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.

- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during field investigation assignments.

- The site leader, HSO, and sampling personnel will maintain project records in a bound notebook (e.g., daily activities, meetings, incidents, and data). Notebooks will remain on-site for the duration of the project so that replacement personnel may add information, thereby maintaining continuity. These notebooks and daily records will become part of the permanent project file.

- During spring, summer and fall wood ticks and deer ticks are prevalent. Deer ticks can transmit Lyme Disease. Special precaution should be taken such as: use of bug spray, duct taping pant cuffs shut, frequent thorough body searches (deer ticks are very small) (see Appendix E).

- Snakes are present at the base, both poisonous and nonpoisonous.

- Poison Ivy is abundant throughout the base.

4.3 PERSONAL PROTECTIVE EQUIPMENT

PPE shields the body against contact with a known or suspected chemical. Descriptions of PPE and procedures for upgrading are presented in this section. Further information regarding PPE can be found in the ABB-ES Health and Safety Program Manual.

4.3.1 Levels of Protection

The following descriptions provide the basic composition of the generally recognized PPE to be used for site operations. Specific components for any level of protection will be selected based on hazard assessment and other elements added as necessary. Disposable protective clothing, gloves, and other equipment, exclusive of respirators, should be used where feasible to minimize risks during decontamination and possible cross-contamination during sample handling.

Level B

- Pressure-demand full-face piece airline respirator must have an escape self contained breathing apparatus (SCBA)

- chemical-resistant clothing (i.e., coveralls and long-sleeved jacket; hooded, one- or two-piece chemical-splash suit; disposable chemical-resistant one-piece suit)

- inner and outer chemical-resistant gloves

- chemical-resistant safety boots/shoes

- hardhat
- two-way radio communications
- disposal boot covers*
- face shield*

Level C

- full-face piece; air-purifying respirator with appropriate sorbents
- chemical-resistant clothing (i.e., coveralls and long-sleeved jacket; hooded, one- or two-piece chemical-splash suit; disposable chemical-resistant one-piece suit)
- inner and outer chemical-resistant gloves
- chemical-resistant safety boots/shoes
- hardhat (required only when overhead hazards exist)
- two-way radio communications
- coveralls*
- disposal boot covers*
- face shield*
- escape mask*

Level D

- coveralls
- safety boots/shoes
- safety glasses or chemical-splash goggles

- hardhat (required only when overhead hazards exist)
- gloves* (required if potential for contact with contaminated materials)
- escape mask*
- face shield*

*optional

Modified Level D

- Same as Level C but no respiratory protection.

4.3.2 Other Protective Equipment

Hearing protection will be worn at all times by personnel when working in and around noise hazardous equipment (i.e., drill rigs). All equipment that generates hazardous noise levels must be identified and the appropriate hearing protective devices recommended as required by DA Pam 40-501. Hearing protection is required any time noise levels exceed 85 dBA. Double hearing protection is required any time noise levels exceed 104 dBA. Posting the area with hazardous noise placards is recommended.

4.3.3 Operational Levels of Protection

The levels on the PID meter for upgrade of PPE were selected based on the ability of the PID to detect the known and suspected chemicals at each site, as well as the relative sensitivity of the PID to the chemicals. Using the most hazardous chemical (i.e., the one with highest expected concentration and/or the lowest permissible exposure limit [PEL] or threshold limit value [TLV]), an action level one half the TLV or PEL for that chemical, whichever was lower, was used. This approach factors in the sensitivity of the PID and accounts for variances due to possible calibration errors, temperature, and unknowns. Because most MAG-1 Area activities are being conducted in open areas (no confined space activities), physical, operational, and climatic factors and their affects on site personnel will be considered in addition to chemical exposure prior to upgrades in personal protective equipment.

Although personnel have been trained in the limitations of the PID during annual refresher and supervisory training courses, the HSO will discuss the action levels selected and the reason for the selections before initiating operations at each site.

5.0 MONITORING

The work environment for both intrusive and non-intrusive activities will be monitored continuously to assure that immediately dangerous to life or health (IDLH) or other dangerous conditions are identified. At a minimum, this monitoring will include evaluations for combustible atmospheres, oxygen-deficient environments, and hazardous concentrations of airborne contaminants. Specific monitoring equipment and action levels are discussed in detail in Section 2.0.

5.1 AIR SAMPLING: EQUIPMENT, CALIBRATION, AND MAINTENANCE

To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct-reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading levels of protection, at the discretion of the site HSO. All monitoring equipment will receive regularly scheduled maintenance. Defective equipment will be flagged for repair by Field Operations Support. Under no circumstances will work proceed with defective equipment unless a higher level of PPE is used and other precautions are taken. All equipment will be calibrated at the start of each day.

5.1.1 ISC MX-241 Dual Detector

This meter monitors for combustible gases and oxygen. It can be used to determine (1) if an area contains concentrations of combustible gases with readings in percentage of the lower explosive limit (LEL); and (2) the percentage of oxygen. This equipment will be calibrated in accordance with the manufacturer's instructions.

This instrument also is calibrated to methane and monitors combustible gases in the percentage of the lower explosive limit. It will be calibrated in accordance with the manufacturer's instructions.

5.1.2 Photovac Organic Vapor Analyzer 10S50

The Organic Vapor Analyzer (OVA) is a total organic vapor analyzer capable of detecting volatile organic compounds (VOCs) that can be ionized by ultraviolet (UV) light. Model 10S50 is commonly used on-site to estimate the presence of VOCs for purposes of crew protection, well screen placement, and selection of samples for further analysis. The principle of operation is twofold: (1) the ambient temperature

gas chromatograph, which breaks down mixtures of VOCs into individual components identified by retention time; and (2) detection accomplished by ionization in UV light. The charged component then moves to an electrode which, in turn, results in a meter deflection proportional to the concentration of the contaminant. This instrument does not read out directly in ppm unless calibrated against the material being measured; therefore, results must be interpreted conservatively and with care. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

5.1.3 HNU IS101 and Photovac TIP Photoionization Detector

Like the OVA, the photoionization detector (PID) operates on the basis of ionization of the contaminant, which results in a meter deflection proportional to the concentration of the contaminant. In the PID, ionization is caused by a UV light source. The strength of the UV, measured in electron volts (eV), determines which contaminants can be ionized. The HNU can use three different-strength UV sources, including 9.6, 10.2, and 11.7 eV; only the 10.2- and 11.7-eV probes are currently available for field use. The TIP operates using a UV light source of 10.6 eV. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

5.1.4 Detector Tubes (MSA and Draeger)

A colorimetric detector tube is a direct-reading instrument consisting of a glass tube impregnated with an indicating chemical, which is connected to a piston cylinder or bellows-type pump. A known volume of air is drawn through the glass tube. The contaminant in the air reacts with the indicator chemical, producing a stain the length of which is proportional to the contaminant's concentration. Care must be taken when using the detector tubes because reliability of the results depends on the proper pump calibration, the degree of stability of the reacting chemical, and the ambient temperature. Interfering gases or vapors can also positively or negatively affect measured results. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

5.1.5 Thermoluminescent Dosimetry Body Badges

These devices are nonmechanical collection devices used to monitor for x-ray, beta, and gamma radiation exposure. The badges are worn by ABB-ES employees and sent quarterly to Tech/Ops Landauer, Inc., for analysis.

5.1.6 Radiation Alert Monitor 4

The Radiation Alert Monitor 4 is a geiger mueller detector that can detect alpha, beta, and gamma radiation. It serves as a radiation detection instrument that indicates the presence of radiation. The detector shall only be used as an alert device to determine when to stop work. This instrument is not used to quantify radiological contamination or potentially contaminated samples. This equipment will be calibrated by the manufacturer.

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6.0 DECONTAMINATION/DISPOSAL

Decontamination workers will wear modified Level D PPE when decontaminating equipment or other personnel. All personnel and/or equipment leaving contaminated site areas will be subject to decontamination, which will take place in the CRZ (see Section 3.1). Procedures to be followed for decontamination of personnel, other small equipment, and heavy equipment and for disposal of decontamination materials are outlined in the following sections.

If Level B or C decontamination procedures are required, the breathing zone of decontamination personnel will be monitored using the procedures outlined in Subsection 2.5.3.3.

6.1 PERSONNEL DECONTAMINATION

Decontamination procedures are followed by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the work site prior to decontamination. Generalized procedures for removal of protective clothing are as follows:

1. Drop tools, monitors, samples, and trash at designated drop stations (i.e., plastic containers or drop sheets) at each work site.

2. Step into the designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots.

3. Scrub outer boots and outer gloves with decon solution or detergent and water. Rinse with water.

4. Remove tape from outer boots and remove boots; discard in disposal container.

5. Remove tape from outer gloves and remove gloves; discard in disposal container.

6. If the worker has left the exclusion zone to change the air tank on his/her SCBA, or the canister on his/her air purifying respirator, this

is the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned, the joints taped, and the worker returns to duty.

7. Remove outer garments and discard in disposal container.

8. Remove respirator and place or hang in the designated area.

9. Remove inner gloves and discard in disposal container.

10. If the work site requires use of a decontamination trailer, all personnel must shower before leaving the site at the end of the work day.

NOTE: Disposable items (i.e., Tyvek coveralls, inner gloves, and latex overboots) will be changed on a daily basis unless there is reason to change sooner. Dual respirator canisters will be changed daily, unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

Respirators will be decontaminated daily and taken from the drop area. The masks will be disassembled, the cartridges set aside, and all other parts placed in a cleansing solution. Parts will be pre-coded (e.g., #1 on all parts of Mask #1). After an appropriate time in the solution, the parts will be removed and rinsed with tap water. Old cartridges will be marked to indicate length of usage (i.e., if means to evaluate the cartridges' remaining utility are available) or will be discarded in the contaminated trash container for disposal. In the morning, the masks will be reassembled and new cartridges installed, if appropriate. Personnel will inspect their own masks and readjust the straps for proper fit.

6.2 SMALL EQUIPMENT DECONTAMINATION

Small equipment will be protected from contamination as much as possible by draping, masking, or otherwise covering the instruments with plastic (to the extent feasible) without hindering operation of the unit. For example, the PID meter can be placed in a clear plastic bag to allow reading the scale and operating the knobs. The PID sensor can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The person performing this activity will usually be at least at modified Level D protection. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes, and dried. The units will be checked, standardized, and recharged as necessary for the next day's operation, and then prepared with new protective coverings.

6.3 HEAVY EQUIPMENT DECONTAMINATION

It is anticipated that drilling rigs, backhoes, etc. will be contaminated during invasive activities. They will be cleaned with high-pressure water. Loose material will be removed with a brush. Solvents will not be used. The person performing this activity will usually be at least at modified Level D protection plus splash protection.

A decontamination pad will be constructed to allow collection and storage of contaminated decontamination fluids in Department of Transportation (DOT)-approved 55-gallon drums. Decontamination procedures are detailed in the Ft. Dix Draft Technical Plan.

6.4 DISPOSAL OF CONTAMINATED MATERIALS

Depending on the levels of personal protection used during the field investigation, contaminated, disposable protective equipment and decon fluids may be generated. If contamination is suspected by non fuel-related compounds, the materials will be screened with a PID, and if appropriate, these materials will be collected and containerized in DOT-approved 55-gallon steel drums.

Soil spoils/cuttings, groundwater well development and purge waters, and decontamination fluids will be containerized in the appropriate DOT-approved containers. The containers will be managed in accordance with Section 2.6 of the Quality Assurance Project Plan.

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7.0 EMERGENCY/CONTINGENCY PLAN

The task HSO is the primary authority for directing operations under emergency conditions. Communications both on- and off-site will be directed through the HSO. Immediately upon identification of an emergency situation, the Ft. Dix Fire Department and the Ft. Dix ambulance service will be notified. Table 7-1 lists these and other relevant telephone numbers. Appendix F of this document lists emergency telephone numbers and Appendix G contains routes to emergency medical facilities.

7.1 EVACUATION

At Ft. Dix, severe hazard conditions are not anticipated. However, in the event that abnormal levels of toxic gases are encountered, the following evacuation measures have been established.

7.1.1 Withdrawal Upwind

The work party will continually note general wind directions while on-site. (A windsock may be set up near the work site for visual determinations.) When conditions warrant moving away from the work site, the crew will relocate upwind a distance of approximately 100 feet or farther, as indicated by site monitoring instruments. Donning an SCBA and a safety harness and line, the HSO and a member of the crew (the buddy system must be used) may return to the work site to determine if the condition noted was transient or persistent. If persistent, an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don an SCBA. An attempt to decrease emissions should be made only if greater respiratory protection is donned. The HSS and Ft. Dix/U.S. Army Environmental Center (USAEC) contacts will be notified of conditions. When site access is restricted, thus hindering escape, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

7.1.2 Work Site Evacuation

When conditions warrant work site evacuation, the work party will proceed upwind of the work site and notify the security force, HSO, and field office of site conditions. If the decontamination area is upwind and greater than 500 feet from the work site,

the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation. If instrumentation indicates an acceptable condition, respirators may be removed. As more information is received from the field crew, it will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the HSO.

7.2 EMERGENCY MEDICAL TREATMENT/FIRST AID

During all site activities, a minimum of two ABB-ES personnel, including the HSO, will be trained in CPR/First Aid.

First aid will be rendered to any person injured on-site, as appropriate. The injured person will then be transported to a medical facility for further examination and/or treatment. The preferred transport method is a professional emergency transportation service; however, when this is not readily available or would result in excessive delay, other transport will be employed. The Ft. Dix ambulance service, telephone (609) 562-3621/3622, will be available for emergency transportation service. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

When an injury occurs in a downrange position, provisions for decontamination of the victim will be made. However, life-threatening conditions may preclude normal decontamination procedures. In such cases, arrangements will be made with the medical facility and transporter to provide for the situation.

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8.0 ACCIDENT/INCIDENT REPORTING

All accidents and injuries occurring at Ft. Dix will be reported to the proper authorities as per Department of the Army, USAEC requirements (DID A012/ DI-A-12963. Accidents resulting in lost-time, illness or hospitalization of 5 or more personnel, fatality or property damage to government or contractor property (which occurred during the performance of the contract) equal to or exceeding $2,000.00 will be reported, via telephone, to the U.S. Army Environmental Center Technical Support Safety (USAEC-TS-S) Branch (410) 671-4811, and the HSM as soon as possible, but not later than 2 hours after the occurrence(s) and reported in writing within 5 days of the occurrence(s) on an Accident Investigation Report. The Ft. Dix Safety Office (609) 562-2889, will be notified as soon as possible after any incident. In addition, a Department of Army Accident Report Form (Appendix H), and an Accident Report Form (Appendix B), will be completed for all accidents involving ABB-ES personnel. These forms will be completed and submitted within 8 hours following the incident. All other accidents/incidents will be reported, via telephone, to the USAEC-TS-S Branch and the HSM within 8 hours of the occurrence.

All injuries will be reported regardless of whether the incident appears to be serious. Likewise, any exposure will be reported even though there may be no adverse health effects or symptoms initially apparent. This is primarily because symptoms of exposure to a toxic agent may often have delayed or latent effects which can only be detected by specific diagnostic tests. Documenting an exposure may aid in identifying the cause of symptoms or changes in health status indicators (diagnostic blood tests or pulmonary function, for example) at a later time. Similarly, an injury, such as an eye injury caused by dust particles, may result in delayed damage to the eye.

The field incident report will be reviewed and signed by the HSO or the Site Operations Leader. The reports will be submitted to the HSM, the HSS, and any other function required by the workers organization. The HSM/HSS will determine the need for further follow-up actions. All exposure incident reports will be made available for review by the examining medical physician during medical monitoring.

9.0 OTHER

9.1 ILLUMINATION

Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light meeting the 5-footcandle requirement of 29 CFR 1910.120, downrange operations must halt in time to permit personnel and equipment to exit the Exclusion Zone and proceed through decontamination during adequate daylight. Conversely, operations will not be permitted to begin until adequate lighting is present.

9.2 EXCAVATION

Site excavations created during site operations will be shored or sloped to prevent accidental collapse and otherwise conducted in accordance with Subpart P of 29 CFR 1926. Under no circumstances will site personnel enter excavations that are not adequately shored or sloped (see Appendix J). Where entry into an excavation does occur and it would even remotely be considered a confined space, such an entry will be made in accordance with the confined space entry program addressed in Section 9.3 and under provision of Appendix I.

9.3 CONFINED SPACE ENTRY

Confined space entry presents special problems and substantial risks to personnel that would be involved directly in the entry and those that might be called on to attempt a rescue of the initial entrants. Therefore, entry into a confined space is a MEANS OF LAST RESORT, and will only be permitted where no other mechanism is feasible to achieve the desired goal.

9.4 DRILLING

All drilling activities will be provided by a subcontractor to be chosen by the contractor. The Drilling Health and Safety Plan will be the responsibility of the subcontractor and will include at a minimum the following safety requirements:

1. Above- and below-ground utility lines may pose a safety hazard to workers during excavation or drilling. The driller must maintain a safe clearance distance (minimum of 20 feet) between overhead utility lines and the drill rig mast at all times. The location of underground utilities must be determined prior to excavation or drilling. No drilling will take place without the identification of underground utility lines by a representative of the utility company(ies) or by the appropriate installation personnel. All permits, licenses, and/or rights-of-entry required by state, local, and/or installation authorities shall be the responsibility of the contractor. These requirements will be identified during the project planning phase.

2. Potential hazards associated with the discharge line and the use of a tremie pipe should be detailed in the drilling safety section of the plan. Additionally, these hazards and how they will be addressed will be explained and emphasized with drillers and their helpers during daily safety briefings.

3. The activities of core or well drilling for the purposes of soil and water sampling involve several safety hazards, i.e., flying debris, hydraulic failures, unguarded machinery, equipment rollover, fire. Accordingly, the following minimum safety precautions will be implemented for contractors conducting drilling or coring operations on behalf of USAEC:

4. The drilling contractor shall have documented safety and emergency action procedures for the equipment to be operated. The drilling contractor's employees will acknowledge in writing that they have read and understand these procedures.

5. The drilling contractor shall ensure that the equipment is well maintained, meets safety requirements, is inspected daily during use, and has all required safety equipment, i.e., 20 lb A:B:C fire extinguisher, emergency stops. Boring tools shall be in good condition and adequate for the work to be performed.

6. The drill rig shall be operated by a qualified operator who can identify pending failures and supervise the driller's helper(s). Transportation

of the drill rig to the work site shall be performed by a person with the proper commercial license.

7. To the extent possible, the terrain should be level (a minimum of 10 feet on each side of drill rig) and the condition of the ground such that unexpected movement of the drill rig is unlikely. If the slope of the terrain is hazardous, the USAEC project officer and the USAEC SES Branch will be contacted for the selection of a safe drill site.

In addition, the drilling subcontractor will be responsible for making sure that all personnel working in and around the drill rig are informed of the location of the kill switch in case of an emergency. The kill switch will be tested daily.

9.5 MOTOR VEHICLES

All contractor/subcontractor personnel must comply with state, local, and installation motor vehicle laws and regulations. This, in addition to any special considerations pertaining to motor vehicle safety, (i.e., current or anticipated hazardous road conditions) will be addressed by the HSO at the daily safety briefings.

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10.0 ADMINISTRATIVE

10.1 PERSONNEL AUTHORIZED DOWNRANGE

Personnel authorized to participate in downrange activities at this site will be reviewed and authorized for site operations by the HSO and the HSS. Authorization involves completion of appropriate training, medical examination, and review of the Ft. Dix HASP. All persons entering the site must utilize the buddy system, and check in with the SOL and/or HSO before going downrange.

10.2 HEALTH AND SAFETY PLAN APPROVALS

By their signature, the undersigned approve this HASP for applicability in the protection of the health and safety of all persons entering the Ft. Dix site.

Health and Safety Officer	Date
ABB-ES Health and Safety Manager	Date

10.3 FIELD TEAM REVIEW

All on-site personnel will be required to sign the Health and Safety Plan Signature Sheet, as indicated below and included in Appendix B.

Site/Project: Ft. Dix RI/FS

I have read and reviewed the HASP and understand the information contained therein and will comply.

NAME	DATE	NAME	DATE

10.4 MEDICAL DATA SHEET

This Medical Data Sheet will be completed by all on-site personnel and will be kept in the Support Zone during the conduct of site operations. It is in no way a substitute for the Medical Surveillance Program requirements consistent with the ABB-ES Corporate Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance is required or if transport to hospital facilities is required. If more information is required, use the back of this sheet. The medical Data Sheet can also be found in Appendix C. Medical Data Sheets will be maintained on site at all times.

MEDICAL DATA SHEET

Project _____

Name _____

Address _____

Home Telephone (___) _____ DOB _____ Height _____ Weight _____

In case of emergency, contact: _____

Address _____

Telephone (___) _____

Do you wear contact lenses? ( ) Yes ( ) No

Allergies _____

List medication taken regularly _____

Particular sensitivities _____

Provide a checklist of previous/recent illnesses or exposures to hazardous chemicals

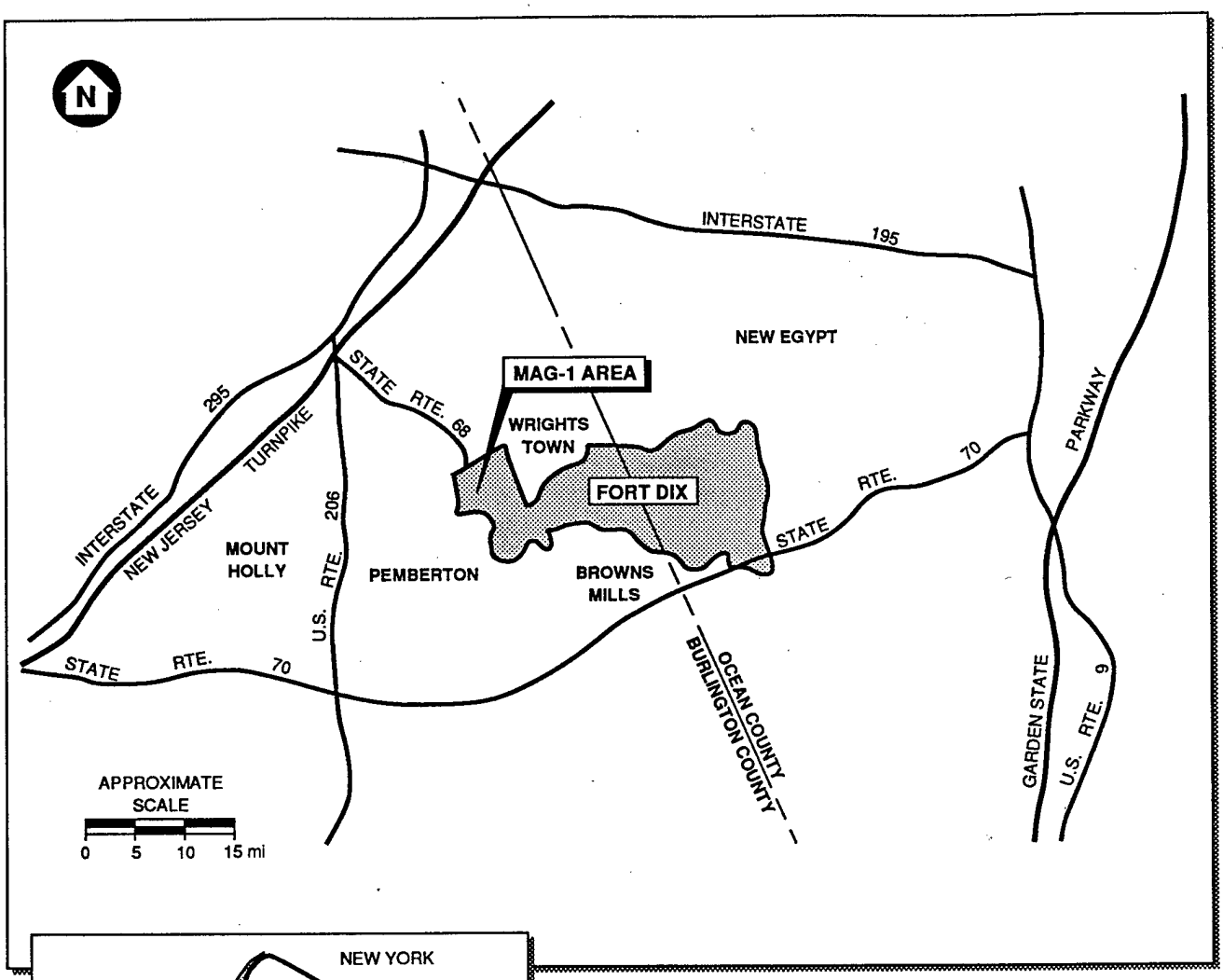
_____

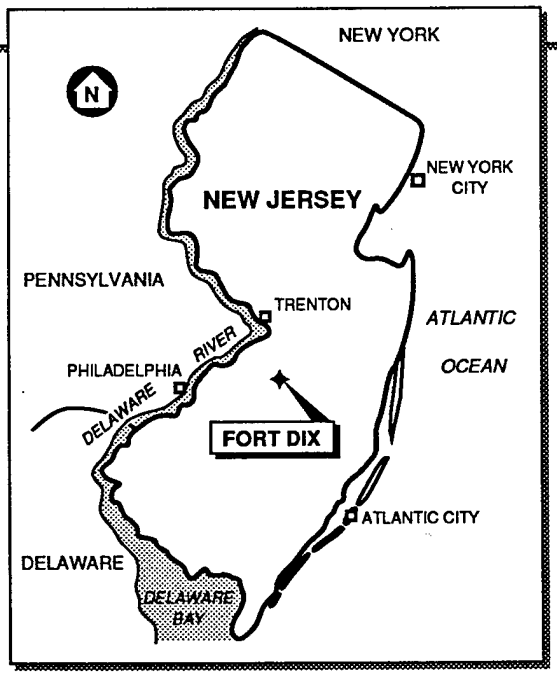
_____

Name of personal physician _____ Telephone (___) _____

ABB-ES	ABB Environmental Services, Inc.
C6H6	benzene
CS2	carbon disulfide
CHRIS	Chemical Hazard Response Information System
COR	Contracting Officer's Representative
CPR	cardiopulmonary resuscitation
CRC	Contamination Reduction Corridor
CRZ	Contamination Reduction Zone
DNT	dinitrotoluene
DOT	Department of Transportation
eV	electron volts
Ft. Dix	Ft. Dix U.S. Army Installation
FS	Feasibility Study
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HCS	Hazard Communication Standard
HMX	cyclotetramethylenetetranitramine
HSM	Health and Safety Manager
HSO	Health and Safety Officer
HSS	Health and Safety Supervisor
IDLH	immediately dangerous to life or health
LEL/O_2	lower explosive limit/oxygen
MAG-1	Magazine Area 1
mg/m^3	milligrams per cubic meter
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer

PB	lead
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
RDX	cyclonite
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SCBA	self contained breathing apparatus
SOL	Site Operations Leader
TLV	threshold limit value
TNT	trinitrotoluene
TRADOC	U.S. Army Training and Doctrine Command
TRCLE	trichloroethene
USAEC	U.S. Army Environmental Center
USAEC-TS-S	U.S. Army Environmental Center - Technical Support Safety
USEPA	U.S. Environmental Protection Agency
UV	ultraviolet
VOC	volatile organic compound





SOURCE: DAMES AND MOORE, 1993.

FIGURE 2-1
MAG-1 LOCATION AT FORT DIX
HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA

ABB Environmental Services, Inc.

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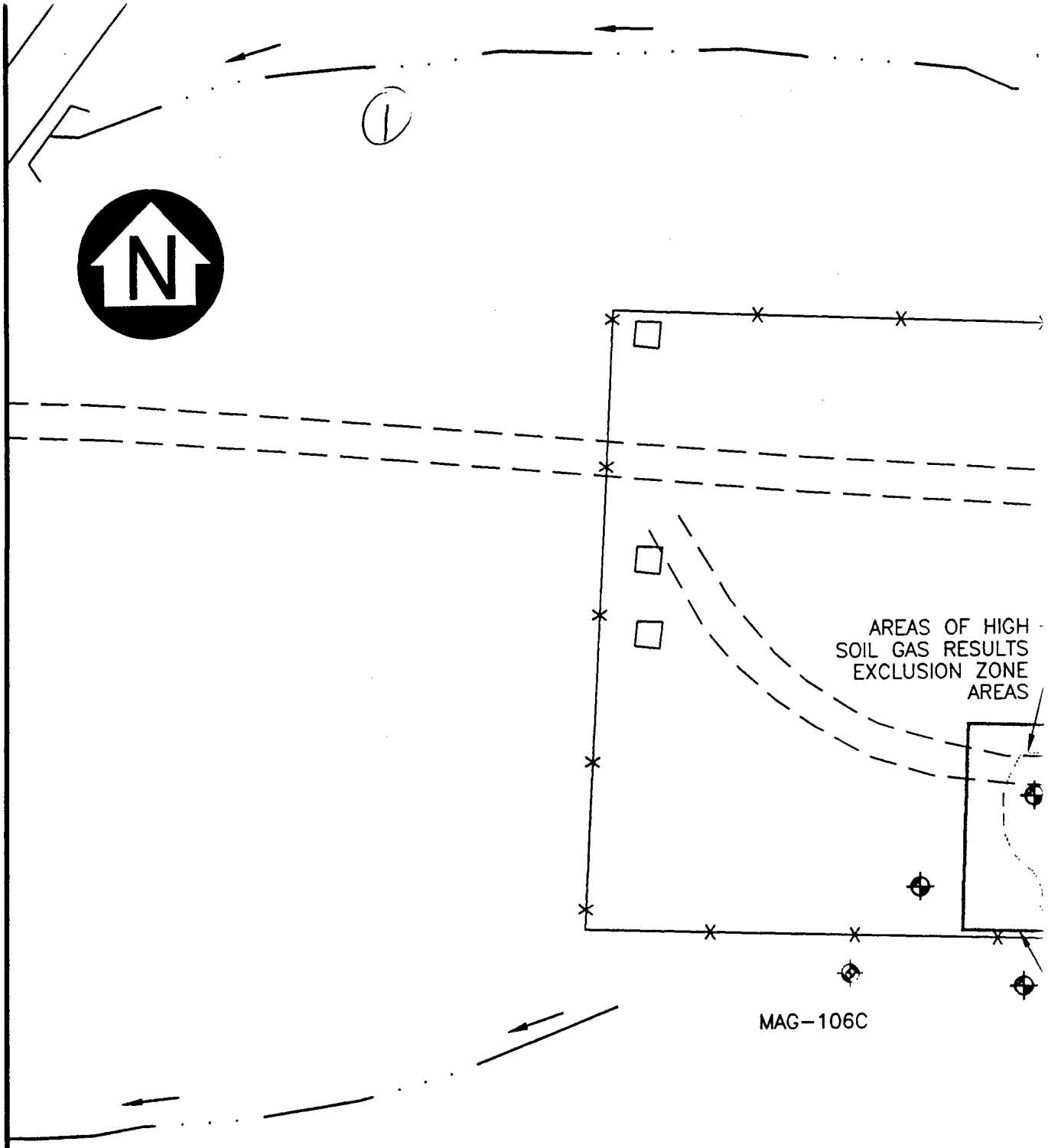

LEGEND

- PROPOSED MONITORING WELL
- PROPOSED SOIL BORING
- CHAIN LINK FENCE
- DIRT ROADS
- PAVED ROADS
- STREAM AND FLOW DIRECTION

NOTES:

1. THE BORING LOCATIONS DEPICTED ARE B/ ON SOIL GAS RESULTS AND LOCATION OF UST AND SEPTIC TANK. THE LOCATIONS A SUBJECT TO CHANGE BASED ON RESULTS THE GPR SURVEY.
2. THE PROPOSED AREA OF INVESTIGATION A EXPLORATION WAS SELECTED BASED ON HISTORICAL AERIAL PHOTOS, THE SOIL GA RESULTS AND ANALYTICAL SOIL BORING D FROM DAMES & MOORE, 1993.
3. CAD BASE MAP SOURCE: FORT DIX.

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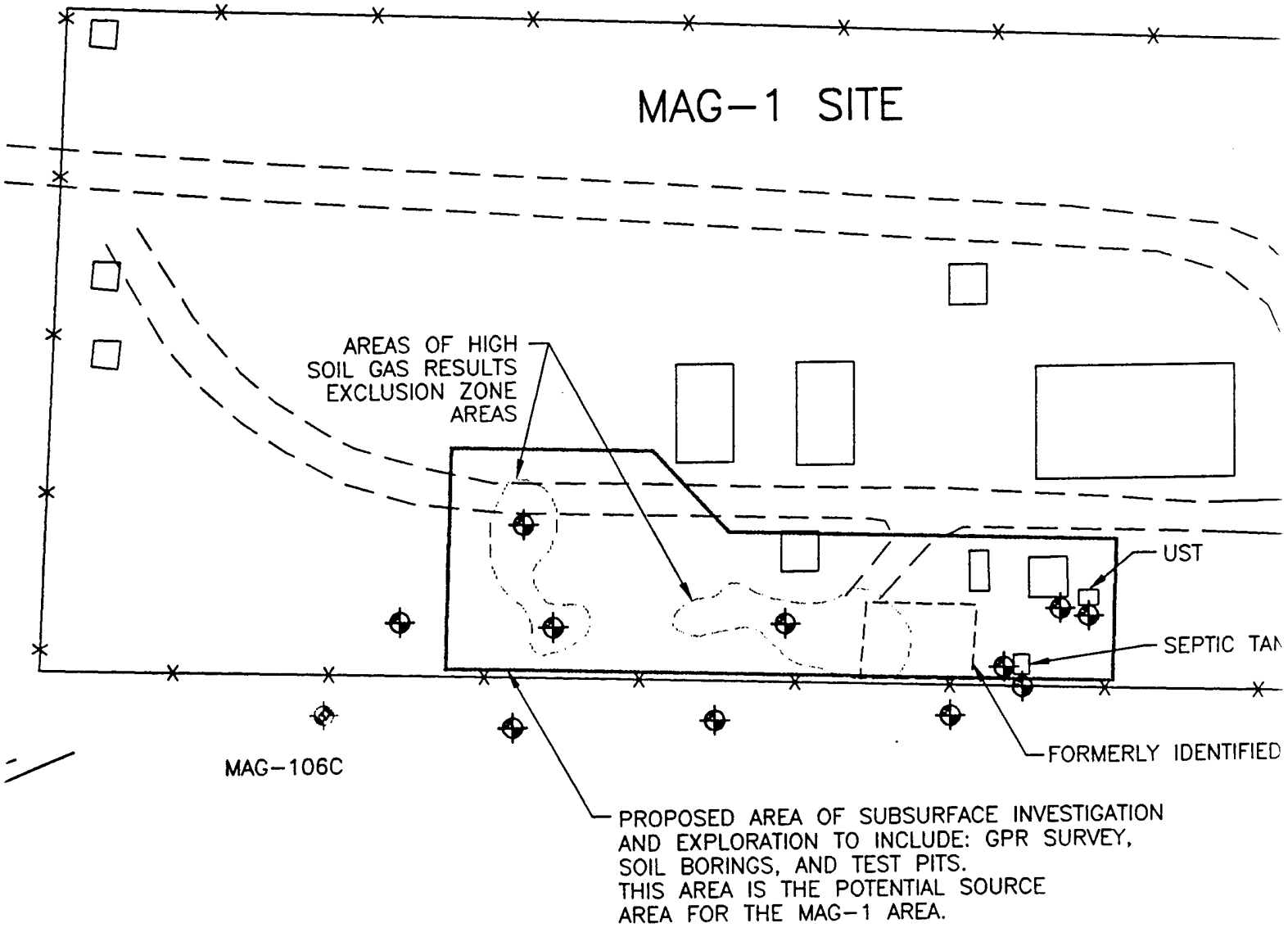
(2)



NOTES:

1. THE BORING LOCATIONS DEPICTED ARE BASED ON SOIL GAS RESULTS AND LOCATION OF UST AND SEPTIC TANK. THE LOCATIONS ARE SUBJECT TO CHANGE BASED ON RESULTS OF THE GPR SURVEY.

2. THE PROPOSED AREA OF INVESTIGATION AND EXPLORATION WAS SELECTED BASED ON HISTORICAL AERIAL PHOTOS, THE SOIL GAS RESULTS AND ANALYTICAL SOIL BORING DATA FROM DAMES & MOORE, 1993.

3. CAD BASE MAP SOURCE: FORT DIX.

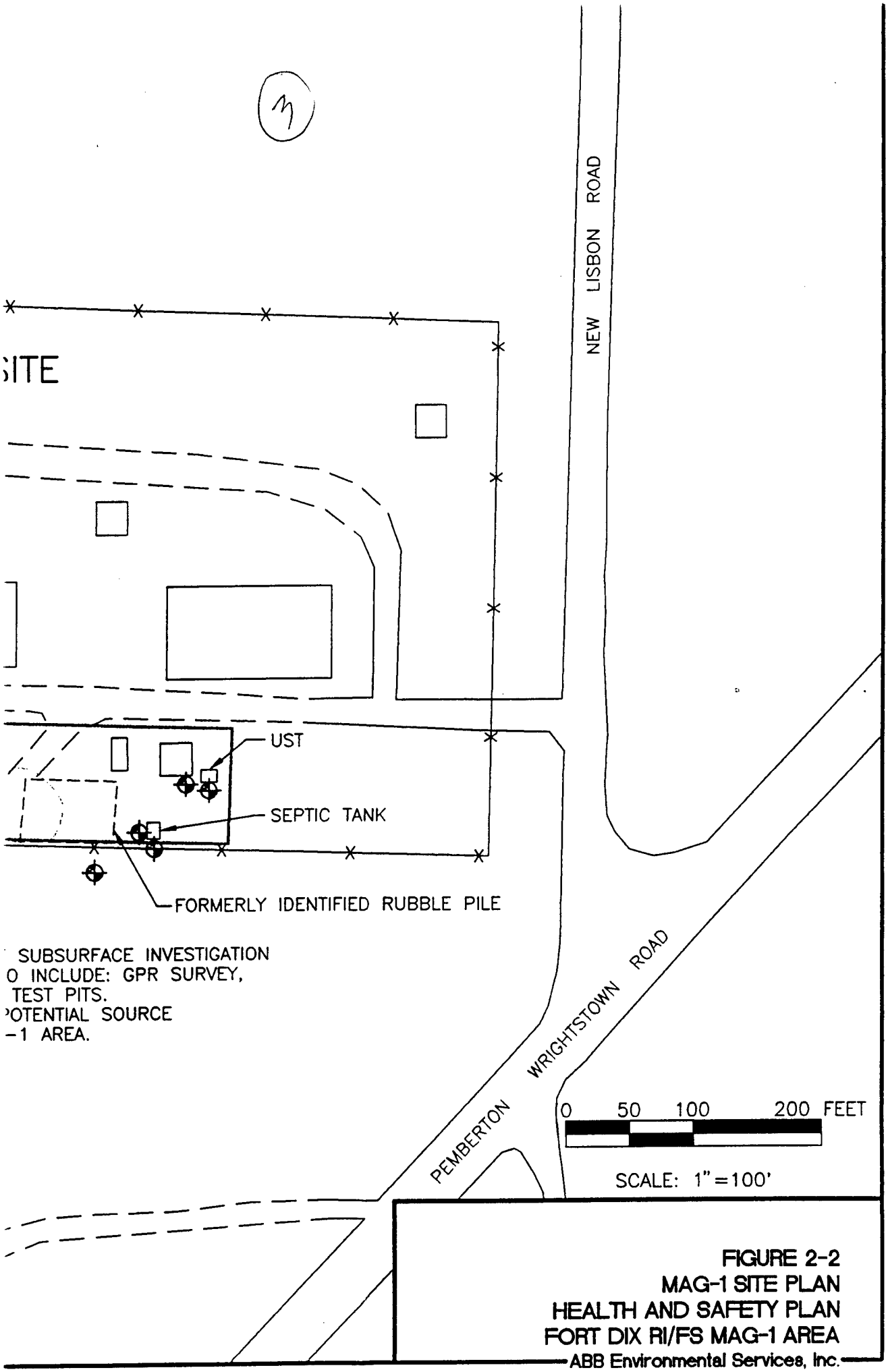


FIGURE 2-2
MAG-1 SITE PLAN
HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA
ABB Environmental Services, Inc.

TABLE 2-1
CONTAMINANTS IDENTIFIED AT THE
MAG-1 AREA

HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA

ANALYTE	GROUNDWATER (ug/l)	SOIL (ug/kg)	SURFACE WATER (ug/l)	SEDIMENTS ug/kg
Oil and Grease	NA	5.4×10^7	2,200	2.4×10^6
Acetone	-	100	-	-
Benzene	-	2	-	-
Carbon disulfide	32	100	-	12
Chloroform	13	-	-	-
Ethylbenzene	0.8	8	-	-
1,1,1-Trichloroethane	-	7	-	-
1,2-Dichloroethene	291	100	67	9
1,1-Dichloroethene	-	-	1	-
Trichloroethene	2,600	19	162	44
Tetrachloroethene	-	11	-	-
Toluene	-	15	-	-
Xylene (total)	33	-	-	-
Trichlorofluoromethane	-	7	-	-
1,3,5-Trinitrobenzene	7	-	-	-
1,3-Dinitrobenzene	1.4	-	-	-
2,4-Dinitrotoluene	1.7	-	-	-
Cyclotetramethylenetetranitramine (HMX)	14.4	-	-	-
Cyclonite (RDX)	23.2	-	-	-
Lead	32	-	-	-
Zinc	342	-	-	-
2'-Hexanone	21	-	-	-
Methyl-isobutyl ketone	20	-	-	-
Styrene	28	-	-	-

TABLE 7-1
IN CASE OF EMERGENCY

HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA

Fire Department:	911
Military Police:	911
Ambulance:	911
Fire Prevention Office:	(609) 562-5484
Installation Safety Office:	Dick Campagna - Safety Coordinator (609) 562-3754
On-Site Medical Facility	Walson Army Hospital (609) 562-2695
USAEC Project Officer	Mike Svizzero (410) 671-1508
USAEC Safety and Environmental Services Branch:	William Houser (410) 671-4811 Work
ABB-ES HSM:	Cindy Sundquist (207) 775-5401 x3601
ABB-ES HSS:	Meg MacLeod (207) 775-5401 x3606
ABB-ES HSO:	Paul Bolmer (207) 775-5401 x3385

FORT DIX CONTRACTOR/SUBCONTRACTOR RULES AND GUIDELINES FOR SECURITY/FIRE PROTECTION

Appendix A
will be provided by the Fort Dix Installation Safety Office

HEALTH AND SAFETY PLAN REVISION FORM

HEALTH AND SAFETY PLAN REVISION FORM - FORT DIX RI/FS

Revision: _____

Date _____ Page: _____

ITEMS REQUIRING REVISION

Existing Text or Description:

Required Revision:

Rationale:

Approval: Health & Safety Officer: _____ Date: _____

Health & Safety Manager: _____ Date: _____

Contracting Officer's Technical Representative: _____ Date: _____

Note: Post approved revisions in front of Health and Safety Plan; use numbered continuation sheets as necessary.

ABB Environmental Services, Inc.

9310013D

HEALTH AND SAFETY FORMS AND DATA SHEETS

Health and Safety Plan Signature Sheet
Medical Data Sheet
Accident Report Form
Job Safety and Health Protection OSHA Poster

HEALTH AND SAFETY PLAN SIGNATURE SHEET

Site/Project: Fort Dix

I have read and reviewed the HASP and understand the information contained therein and will comply.

Name	Date	Name	Date

MEDICAL DATA SHEET

Project _____

Name _____

Address _____

Home Telephone (___)_____ DOB _____ Height _____ Weight _____

In case of emergency, contact: _____

Address _____

Telephone (___)_____

Do you wear contact lenses? ( ) Yes ( ) No

Allergies _____

List medication taken regularly _____

Particular sensitivities _____

Provide a checklist of previous/recent illnesses or exposures to hazardous chemicals

_____

_____

Name of personal physician _____ Telephone (___)_____

_____

ABB ENVIRONMENTAL SERVICES INC.
ACCIDENT REPORT

SITE INFORMATION:

Site:_____ Job Number:_____
Location:_____
Location of Accident (if different from above):_____
Did injury involve ABB–ES employee?:_____ Subcontractor?:_____ Other?:_____

PERSONAL INFORMATION:

Name of Injured Person:_____
Address of Injured Person:_____
SSN:_____ DOB:_____ Marital Status:_____
Department:_____ Date of Hire:_____

ACCIDENT INFORMATION:

Date of Accident:_____ Time of Accident:_____ Weather Conditions:_____
Name of Witness:_____ Telephone No.:_____
Address:_____

Accident Category: ☐ Chemical Exposure ☐ Physical Injury ☐ Motor Vehicle ☐ Fire
☐ Property Damage (list):_____ ☐ Other:_____

Severity: ☐ Medical Treatment ☐ Non–disabling ☐ Disabling ☐ Fatality
☐ Estimated Amount of Property Damage:_____

Classification of Injury:

☐ Heat Burns	☐ Allergic Reaction	☐ Lacerations	☐ Fracture
☐ Chemical Burns	☐ Bites	☐ Punctures	☐ Dislocations
☐ Radiation Burns	☐ Poison Ivy	☐ Abrasions	☐ Nausea
☐ Toxic–Respiratory	☐ Heat Stroke	☐ Sprains	☐ Headache
☐ Toxic–Dermal	☐ Cold Exposure	☐ Bruises	☐ Faint/Dizzy
☐ Toxic–Ingestion	☐ Blisters	☐ Concussion	

☐ Other:_____

If chemical exposure, list all possible contaminants of concern:_____

Part(s) of Body Affected:_____ Degree of Disability:_____
Date Medical Care Received:_____ Emergency Service:_____ Follow–up Examination Needed:_____
Name and Address of Medical Facility:_____

Name of Attending Physician:_____ Telephone Number:_____
Date/Time Employee went back to work:_____ Employee on Restricted Duty?_____
Estimated Number of Days Away From Work:_____

CAUSE OF INJURY/ACCIDENT:

Causitive agent(s) most directly related to accident (e.g., object, substance, material, machinery, equipment, or weather):_____

Were there unsafe mechanical/physical/environmental condition(s) at the time of the accident?:_____

Did an unsafe act contribute to the accident? If yes, specify:_____

Did personal factors contribute to the accident (e.g., improper attitude, lack of knowledge or skill, slow reaction, fatigue, inattention, or horseplay.):_____

ACCIDENT PREVENTION:

Level of Personal Protective Equipment required in the HASP:_____
Was injured using required equipment?:_____. If not, how did actual equipment differ from what was required in the HASP. Describe:_____

Was personal protective equipment required in the HASP adequate for site conditions?_____
If no, what additional equipment was needed?:_____

What can be done to prevent a re-occurrence of this type of accident? (e.g., ventilation, machine modification/ guarding, modification of work practices, or additional training.):_____

NARRATIVE:

Provide a detailed description of how and why the accident occured. Include objects, equipment, tools, circumstances of assigned duties, weather, etc. Be specific.:_____

Signature of Preparer:_____ Date:_____
Signature of Site Manager:_____ Date:_____

SEND A COPY OF THE COMPLETED FORM TO THE MANAGER, HEALTH AND SAFETY – PORTLAND, ME.

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

AUGUSTA AREA OFFICE
FEDERAL BLDG. & P. O.
40 WESTERN AVE., RM. 121
AUGUSTA, MAINE 04330
TEL. (207) 622-8417

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203

William E. Brock, Secretary of Labor

U.S. Department of Labor
Occupational Safety and Health Administration

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or a facsimile) in a conspicuous place where notices to employees are customarily posted.

CHEMICAL HAZARD RESPONSE INFORMATION SYSTEM

(CHRIS) DATA SHEETS

CHRIS DATA SHEETS PROVIDED FOR THE FOLLOWING:

Acetone
Alconox
Bentonite: Puregold Gel
Bentonite: Puregold Grout
Benzene
Carbon Disulfide
Chloroform
Ethylbenzene
Gasolines: automotive (<4.23 g lead/gal.)
1,1-Dichloroethane
tetrachloroethane
trichloroethane
methyl isobutyl ketone
1,3-Dinitrobenzene
2,4-Dinitrotoluene
m-xylene
Oils, fuel: 1-D
Oils, fuel: 2
Oils, fuel: 2-D
Oils, fuel: 4
Oils, fuel: 5
Oils, fuel: No. 1
Oils, fuel: No. 6
Oils, miscellaneous: lubricating
o-xylene
Portland cement
p-xylene
Sodium hydroxide
trichlorofluoromethane
toluene
styrene
hydrochloric acid
hexane
sulfuric acid
methanol
nitric acid
1,1,1-trichloroethane
cyclotetramethylenetetranitramine
cyclonite
1,3,5-trinitrobenzene
lead
isobutylene

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ACETONE

ACT

Common Synonyms	Watery liquid	Colorless	Sweet odor
Dimethyl ketone Propanone 2-Propanone	Floats and mixes with water. Flammable, irritating vapor is produced.		

Stay upwind and use water spray to "knock down" vapor.
Shut off ignition sources and call fire department. Keep people away.
Stop discharge if possible.
Isolate and remove discharged material.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, may cause difficult breathing or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to eyes.
Not irritating to skin.
IF IN EYES, hold eyelids open and flush with plenty of water.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Disperse and flush

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Ketone
3.2 Formula: CH_3COCH_3
3.3 IMO/UN Designation: 3.1/1090
3.4 DOT ID No.: 1090
3.5 CAS Registry No.: 67-64-1

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Sweetish; pleasant, resembling that of mint or fruit; pungent; sharp, penetrating residual; ketonic, pleasant, non-residual

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor canister or air-supplied mask; synthetic rubber gloves; chemical safety goggles or face splash shield.

5.2 Symptoms Following Exposure: INHALATION: vapor irritating to eyes and mucous membranes; acts as an anesthetic in very high concentrations. INGESTION: low order of toxicity but very irritating to mucous membranes. SKIN: prolonged excessive contact causes defatting of the skin, possibly leading to dermatitis.

5.3 Treatment of Exposure: INHALATION: if victim is overcome, remove to fresh air and call a physician; administer artificial respiration if breathing is irregular or stopped. INGESTION: if victim has swallowed large amounts and is conscious and not having convulsions, induce vomiting and get medical help promptly; no specific antidote known. SKIN: wash well with water. EYES: flush with water immediately for at least 15 min. Consult a physician.

5.4 Threshold Limit Value: 750 ppm

5.5 Short Term Inhalation Limits: 1000 ppm for 30 min.

5.6 Toxicity by Ingestion: Grade 1; LD_{50} . . . 5 to 15 g/kg (dog)

5.7 Late Toxicity: Not pertinent

5.8 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors cause moderate irritation of the eyes or respiratory system. Effect is temporary.

5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin because it is very volatile and evaporates quickly from the skin.

5.10 Odor Threshold: 100 ppm

5.11 IDLH Value: 20000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 4°F O.C.; 0°F C.C.
6.2 Flammable Limits in Air: 2.6%-12.8%
6.3 Fire Extinguishing Agents: Alcohol foam, dry chemical, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water in straight hose stream will scatter and spread fire and should not be used.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 869°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 3.9 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 18

8. WATER POLLUTION

8.1 Aquatic Toxicity:
14,250 ppm/24 hr/sunfish/killed/tap water
13,000 ppm/48 hr/mosquito fish/TL_m/ turbid water
8.2 Waterfowl Toxicity: Not pertinent
8.3 Biological Oxygen Demand (BOD): (Theor) 122%, 5 days
8.4 Food Chain Concentration Potential: None noted

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical: 99.5% plus 0.5% water Reagent: 99.5% plus 0.5% water
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations:
Flammable liquid

11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	0
Poisons	0
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	1
Reactivity	
Other Chemicals	1
Water	2
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15 C and 1 atm: Liquid
12.2 Molecular Weight: 58.08
12.3 Boiling Point at 1 atm: 133°F 56.1 C 329.3 K
12.4 Freezing Point: —138°F —94.7 C 178.5 K
12.5 Critical Temperature: 455°F 235 C 508 K
12.6 Critical Pressure: 682 psa 46.4 atm 4.70 MN/m^2
12.7 Specific Gravity: 0.791 at 20 C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 2.0
12.11 Ratio of Specific Heats of Vapor (Gas): 1.127
12.12 Latent Heat of Vaporization: 220 Btu/lb 122 cal/g 5.11×10^5 J/kg
12.13 Heat of Combustion: —12,250 Btu/lb —6808 cal/g -285.0×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 23.42 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 7.25 psia

NOTES

ACETONE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—120	56.350
—110	55.980
—100	55.620
—90	55.250
—80	54.880
—70	54.520
—60	54.150
—50	53.780
—40	53.400
—30	53.030
—20	52.650
—10	52.280
0	51.900
10	51.520
20	51.140
30	50.760
40	50.380
50	50.000
60	49.610
70	49.230
80	48.840
90	48.450
100	48.070
110	47.680
120	47.280

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
34	.507
36	.508
38	.508
40	.509
42	.510
44	.511
46	.512
48	.513
50	.514
52	.514
54	.515
56	.516
58	.517
60	.518
62	.519
64	.519
66	.520
68	.521
70	.522
72	.523
74	.524
76	.525
78	.525
80	.526
82	.527
84	.528

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
30	1.193
35	1.184
40	1.174
45	1.164
50	1.155
55	1.145
60	1.135
65	1.126
70	1.116
75	1.106
80	1.097
85	1.087
90	1.077
95	1.068
100	1.058
105	1.048

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	MISCIBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—20	.245
—10	.35
0	.50
10	.69
20	.95
30	1.291
40	1.719
50	2.260
60	2.935
70	3.770
80	4.791
[illegible]	6.029
[illegible]	7.516
[illegible]	9.290
120	11.390
130	13.850
140	16.720
150	20.060
160	23.890
170	28.290
180	33.300
190	38.980

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—20	.00302
—10	.00426
0	.00590
10	.00804
20	.01079
30	.01427
40	.01862
50	.02399
60	.03056
70	.03851
80	.04803
90	.05934
100	.07266
110	.08823
120	.10630
130	.12710
140	.15090
150	.17800
160	.20860
170	.24310
180	.28170
190	.32460

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.275
25	.286
50	.296
75	.307
100	.317
125	.327
150	.337
175	.347
200	.357
225	.367
250	.377
275	.386
300	.395
325	.405
350	.414
375	.423
400	.431
425	.440
450	.449
475	.457
500	.466
525	.474
550	.482
575	.490
600	.498

FROM: ALCONOX, Inc.

Quality Detergents for Laboratory, Hospital, Industry
215 PARK AVENUE SOUTH NEW YORK, N.Y.

TO: CE Environmental

ATTN: Bill Thurston

FAX: 207-773-0011

DATE: 11/19/90

PAGE 1 OF 6

FROM: Malcolm

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List): LIQUI-NOX

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name: ALCONOX, INC.
Address (Number, Street, City, State, and ZIP Code): 215 PARK AVENUE SOUTH, NEW YORK, NEW YORK 10003
Emergency Telephone Number: (212) 473-1300
Telephone Number for Information: (212) 473-1300
Date Prepared: JULY 1, 1987
Signature of Preparer (optional):

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
THERE ARE NO INGREDIENTS IN LIQUI-NOX WHICH APPEARED ON THE OSHA STANDARD 29 CFR 1910 SUBPART Z.				

Section III — Physical/Chemical Characteristics

Boiling Point	214°F	Specific Gravity (H_2O = 1)	1.075
Vapor Pressure (mm Hg)	NO DATA	Melting Point	N.A.
Vapor Density (Air = 1)	NO DATA	Evaporation Rate (Butyl Acetate = 1)	NO DATA

Solubility in Water: COMPLETELY SOLUBLE IN ALL PROPORTIONS
Appearance and Odor: YELLOW LIQUID - PRACTICALLY ODORLESS

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used): NONE (CLEVELAND OPEN CUP)
Flammable Limits: LEL N.A. UEL N.A.
Extinguishing Media: WATER, DRY CHEMICAL, FOAM, CO_2, SAND/EARTH
Special Fire Fighting Procedures: FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER WITHOUT PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS.
Unusual Fire and Explosion Hazards: NONE

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid: NONE
	Stable	XX	

Incompatibility (Materials to Avoid): NONE
Hazardous Decomposition or Byproducts: SO_2 MAY BE RELEASED ON BURNING

Hazardous Polymerization	May Occur		Conditions to Avoid: NONE
	Will Not Occur	XX	

Section VI — Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
	NO	YES	YES

Health Hazards (Acute and Chronic): SKIN CONTACT MAY PROVE LOCALLY IRRITATING.
INGESTION MAY CAUSE DISCOMFORT AND/OR DIARRHEA.

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
	NO	NO	NO

Signs and Symptoms of Exposure: PROLONGED SKIN CONTACT MAY CAUSE DRYING AND/OR CHAPPIN
Medical Conditions Generally Aggravated by Exposure: NONE

Emergency and First Aid Procedures: EYES-FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SKIN-FLUSH WITH WATER.
INGESTION-DRINK LARGE QUANTITIES OF WATER. GET MEDICAL ATTENTION FOR DI

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled: MATERIAL FOAMS PROFUSELY. RECOVER AS MUCH AS POSSIBLE WITH ABSORBENT MATERIAL AND RINSE REMAINDER TO SEWER. MATERIAL IS COMPLETELY BIODEGRADA
Waste Disposal Method: SMALL QUANTITIES MAY BE DISPOSED OF IN SEWER. LARGE QUANTITIES SHOULD BE SOAKED UP WITH ABSORBENT MATERIAL AND DISPOSED OF ACCORDING TO LOCAL ORDI
Precautions to Be Taken in Handling and Storing: NONE REQUIRED -VISCOSITY OF MATERIAL INCREASES AT VERY LOW TEMPERATURES.

Other Precautions: NO SPECIAL REQUIREMENTS OTHER THAN THE GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES EMPLOYED WITH ANY INDUSTRIAL CHEMICAL.

Section VIII — Control Measures

Respiratory Protection (Specify Type)

Ventilation	Local Exhaust: NORMAL	Special: N.A.	
	Mechanical (General): N.A.	Other: N.A.	

Protective Gloves: RECOMMENDED
Eye Protection: RECOMMENDED
Other Protective Clothing or Equipment: NOT REQUIRED
Work/Hygienic Practices: NO SPECIAL PRACTICES REQUIRED

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AMERICAN COLLOID COMPANY

One North Arlington
Arlington Heights, Illinois
(708) 392-4600 • Telex
Fax (708) 506-5188

MATERIAL SAFETY DATA SHEET - May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

218
101

PRODUCT NAME: PUREGOLD GEL

Section I MANUFACTURER'S INFORMATION

Manufacturer's Name & Address:

American Colloid Company
1500 West Shure Drive
One North Arlington
Arlington Heights, Illinois 60004

Emergency Telephone Number: 708-392-4600
Telephone Number for Information: 708-392-4600
Date Prepared: April 28, 1993

Section II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components (Specific Chemical Identity: Common Name(s))		OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Crystalline Quartz CAS# 14808-60-7 (naturally occurring contaminant)		-	-	*	2-6%
Respirable Crystalline Quartz				NIOSH	
	present (TWA)	0.1mg/m^3	0.1mg/m^3 TWA	50ug/m^3 TWA	<2%
	proposed (TWA)		50ug/m^3 TWA	-	-
Nuisance Dust					
-	Respirable	5mg/m^3	5mg/m^3	-	-
-	Total Dust	15mg/m^3	10mg/m^3	-	-

* **WARNING:**
This clay product contains a small amount of crystalline silica which may cause delayed respiratory disease if inhaled over a prolonged period of time. Avoid breathing dust. Use NIOSH/MSHA approved respirator where TLV for crystalline silica may be exceeded. IARC Monographs on the evaluation of the Carcinogenic Risk of Chemicals to Humans (volume 42, 1987) concludes that there is "limited evidence" of the carcinogenicity of crystalline silica to humans. IARC classification 2A.

PRODUCT IDENTIFICATION

Chemical Name: Bentonite Clay (100%)
Chemical Family: Natural Mineral, Montmorillonite
CAS No.: 1302-78-9 Bentonite is on the TSCA inventory.
FORMULA: Naturally occurring hydrated aluminosilicate of sodium, calcium, magnesium, and iron
NFPA/HMIS: Health - 1, Fire - 0, Reactivity - 0, Specific Hazard - See Section VI
Dot Class: Not Regulated

AMERICAN COLLOID COMPANY

One North Arlington • [illegible]
Arlington Heights, Illinois [illegible]
(708) 392-4600 • Telex [illegible]
Fax (708) 506-6188

218
101

PRODUCT NAME: PUREGOLD GEL

Section III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point	- Not Applicable	Specific Gravity (H_2O = 1)	- 2.5
Vapor Pressure (mm Hg.)	- Not Applicable	Melting Point	- Not Applicable
Vapor Density (AIR = 1)	- Not Applicable	Evaporation Rate (Butyl Acetate = 1)	- Not Applicable
Solubility in Water	- Negligible		
Appearance and Odor	- Pale grey to buff powder or granules, odorless		

Section IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used) - Not Applicable
Flammable Limits - Not Applicable LEL- • UEL- •
Extinguishing Media - Not Applicable
Special Fire Fighting Procedures - Inorganic Mineral/Non-Flammable
Unusual Fire and Explosion Hazards - Not Applicable

Section V REACTIVITY DATA

Stability Unstable - • Conditions to Avoid - None Known
Stable - X

Incompatibility (Materials to Avoid) - None Known
Hazardous Decomposition or By-products - None Known

Hazardous Polymerization May Occur - • Conditions to Avoid - None Known
Will Not Occur - X

Section VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes Skin? No Ingestion? No
Health Hazards (Acute and Chronic) - May cause delayed respiratory disease if dust inhaled over a prolonged period of time.

Carcinogenicity: NTP? No IARC Monographs? Yes OSHA Regulated? No

IARC Monographs on the evaluation of the Carcinogenic Risk of Chemicals to Humans (volume 42, 1987) concludes that there is "limited evidence" of the carcinogenicity of crystalline silica to humans. IARC classification 2A.

Signs and Symptoms of Exposure - Excessive inhalation of dust may result in shortness of breath and reduced pulmonary function.

Medical Conditions Generally Aggravated by Exposure - Individuals with pulmonary and/or respiratory disease including but not limited to asthma and bronchitis should be precluded from exposure to dust.

Emergency and First Aid Procedures - Eyes - Flush with water.
- Gross inhalation of dust - Remove to fresh air; give oxygen or artificial respiration if necessary; get medical attention.

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PRODUCT NAME: PUREGOLD GEL

Section VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled - Vacuum if possible to avoid generating airborne dust. Avoid breathing dust. Wear an approved respirator. Avoid adding water, the product will become slippery when wet.

Waste Disposal Method - Follow federal, state and local regulations for solid waste.

Precautions to Be Taken in Handling and Storing - Avoid breathing dust, use NIOSH/MSHA approved respirator where TLV limits for Crystalline Silica may be exceeded.

Other Precautions - Slippery when wet.

Section VIII CONTROL MEASURES

Respiratory Protection (Specify Type) - OSHA standard 1910.134 or ANSI Z88.2-1980 specification.

Ventilation	- Local Exhaust	- As appropriate	Special	- None
	- Mechanical (General)	- As appropriate	Other	- None
Protective Gloves	- Not Required		Eye Protection	- Recommended
Other Protective Clothing or Equipment	- None			
Work/Hygienic Practices	- Use good housekeeping practices.			

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MATERIAL SAFETY DATA SHEET • May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

69903
101

PRODUCT NAME: PUREGOLD GROUT

Section I MANUFACTURER'S INFORMATION

Manufacturer's Name & Address:

American Colloid Company
1500 West Shure Drive
One North Arlington
Arlington Heights, Illinois 60004

Emergency Telephone Number: 708-392-4600
Telephone Number for Information: 708-392-4600
Date Prepared: April 28, 1993

Section II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Hazardous Components (Specific Chemical Identity: Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Crystalline Quartz CAS# 14808-60-7 (naturally occurring contaminant)	-	-	*	2-6%
Respirable Crystalline Quartz			NIOSH	
present (TWA)	0.1mg/m^3	0.1mg/m^3 TWA	50ug/m^3 TWA	<2%
proposed (TWA)		50ug/m^3 TWA	-	-
Nuisance Dust				
- Respirable	5mg/m^3	5mg/m^3	-	-
- Total Dust	15mg/m^3	10mg/m^3	-	-

* **WARNING:**
This clay product contains a small amount of crystalline silica which may cause delayed respiratory disease if inhaled over a prolonged period of time. Avoid breathing dust. Use NIOSH/MSHA approved respirator where TLV for crystalline silica may be exceeded. IARC Monographs on the evaluation of the Carcinogenic Risk of Chemicals to Humans (volume 42, 1987) concludes that there is "limited evidence" of the carcinogenicity of crystalline silica to humans. IARC classification 2A.

PRODUCT IDENTIFICATION

Chemical Name: Bentonite Clay (100%)
Chemical Family: Natural Mineral, Montmorillonite
CAS No.: 1302-78-9 Bentonite is on the TSCA inventory.
FORMULA: Naturally occurring hydrated aluminosilicate of sodium, calcium, magnesium, and iron
NFPA/HMIS: Health - 1, Fire - 0, Reactivity - 0, Specific Hazard - See Section VI
Dot Class: Not Regulated

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69903
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PRODUCT NAME: PUREGOLD GROUT

Section III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point	- Not Applicable	Specific Gravity (H_2O = 1)	- 2.5
Vapor Pressure (mm Hg.)	- Not Applicable	Melting Point	- Not Applicable
Vapor Density (AIR = 1)	- Not Applicable	Evaporation Rate (Butyl Acetate = 1)	- Not Applicable
Solubility in Water	- Negligible		
Appearance and Odor	- Pale grey to buff powder or granules, odorless		

Section IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used)	- Not Applicable		
Flammable Limits	- Not Applicable	LEL- -	UEL- -
Extinguishing Media	- Not Applicable		
Special Fire Fighting Procedures	- Inorganic Mineral/Non-Flammable		
Unusual Fire and Explosion Hazards	- Not Applicable		

Section V REACTIVITY DATA

Stability — Unstable - ; Stable - X — Conditions to Avoid - None Known

Incompatibility (Materials to Avoid) - None Known
Hazardous Decomposition or By-products - None Known

Hazardous Polymerization — May Occur - ; Will Not Occur - X — Conditions to Avoid - None Known

Section VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes Skin? No Ingestion? No
Health Hazards (Acute and Chronic) - May cause delayed respiratory disease if dust inhaled over a prolonged period of time.

Carcinogenicity: NTP? No IARC Monographs? Yes OSHA Regulated? No

IARC Monographs on the evaluation of the Carcinogenic Risk of Chemicals to Humans (volume 42, 1987) concludes that there is "limited evidence" of the carcinogenicity of crystalline silica to humans. IARC classification 2A.

Signs and Symptoms of Exposure - Excessive inhalation of dust may result in shortness of breath and reduced pulmonary function.

Medical Conditions Generally Aggravated by Exposure - Individuals with pulmonary and/or respiratory disease including but not limited to asthma and bronchitis should be precluded from exposure to dust.

Emergency and First Aid Procedures - Eyes - Flush with water.
- Gross inhalation of dust - Remove to fresh air; give oxygen or artificial respiration if necessary; get medical attention.

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PRODUCT NAME: PUREGOLD GROUT

Section VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled - Vacuum if possible to avoid generating airborne dust. Avoid breathing dust. Wear an approved respirator. Avoid adding water, the product will become slippery when wet.

Waste Disposal Method - Follow federal, state and local regulations for solid waste.

Precautions to Be Taken in Handling and Storing - Avoid breathing dust, use NIOSH/MSHA approved respirator where TLV limits for Crystalline Silica may be exceeded.

Other Precautions - Slippery when wet.

Section VIII CONTROL MEASURES

Respiratory Protection (Specify Type) - OSHA standard 1910.134 or ANSI Z88.2-1980 specification.

Ventilation - Local Exhaust - As appropriate
- Mechanical (General) - As appropriate

Special - None
Other - None

Protective Gloves - Not Required

Eye Protection - Recommended

Other Protective Clothing or Equipment - None

Work/Hygienic Practices - Use good housekeeping practices.

BENZENE

BNZ

Common Synonyms
Benzol
Benzole

Watery liquid | Colorless | Gasoline-like odor

Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Restrict access

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** C_6H_6
3.3 **IMO/UN Designation:** 3.2/1114
3.4 **DOT ID No.:** 1114
3.5 **CAS Registry No.:** 71-43-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Aromatic; rather pleasant aromatic odor; characteristic odor

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Hydrocarbon vapor canister, supplied air or a hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.
5.2 **Symptoms Following Exposure:** Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death.
5.3 **Treatment of Exposure:** SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** 75 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Leukemia
5.8 **Vapor (Gas) Irritant Characteristics:** If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 4.68 ppm
5.11 **IDLH Value:** 2,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 12°F C.C.
6.2 **Flammable Limits in Air:** 1.3%-7.9%
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back
6.7 **Ignition Temperature:** 1097°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 6.0 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 5 ppm/6 hr/minnow/lethal/distilled water
20 ppm/24 hr/sunfish/TL_m/tap water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 1.2 lb/lb, 10 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:**
Industrial pure .....99+%
Thiophene-free .....99+%
Nitration .....99+%
Industrial 90% .....85+%
Reagent .....99+%
9.2 **Storage Temperature:** Open
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 78.11
12.3 **Boiling Point at 1 atm:** 176°F = 80.1°C = 353.3°K
12.4 **Freezing Point:** 42.0°F = 5.5°C = 278.7°K
12.5 **Critical Temperature:** 552.0°F = 288.9°C = 562.1°K
12.6 **Critical Pressure:** 710 psia = 48.3 atm = 4.89 MN/m²
12.7 **Specific Gravity:** 0.879 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 28.9 dynes/cm = 0.0289 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 35.0 dynes/cm = 0.035 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 2.7
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.061
12.12 **Latent Heat of Vaporization:** 169 Btu/lb = 94.1 cal/g = 3.94 X 10^5 J/kg
12.13 **Heat of Combustion:** —17,460 Btu/lb = —9698 cal/g = —406.0 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 30.45 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 3.22 psia

NOTES

BENZENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
55	55.330
60	55.140
65	54.960
70	54.770
75	54.580
80	54.400
85	54.210
90	54.030
95	53.840
100	53.660
105	53.470
110	53.290
115	53.100
120	52.920
125	52.730
130	52.540
135	52.360
140	52.170
145	51.990
150	51.800
155	51.620
160	51.430
165	51.250
170	51.060
175	50.870

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
45	.394
50	.396
55	.398
60	.400
65	.403
70	.405
75	.407
80	.409
85	.411
90	.414
95	.416
100	.418

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
75	.988
80	.981
85	.975
90	.969
95	.962
100	.956
105	.950
110	.944
115	.937
120	.931
125	.925
130	.919
135	.912
140	.906
145	.900
150	.893
155	.887
160	.881
165	.875
170	.868

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
55	.724
60	.693
65	.665
70	.638
75	.612
80	.588
85	.566
90	.544
95	.524
100	.505
105	.487
110	.470
115	.453
120	.438

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.180

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
50	.881
60	1.171
70	1.535
80	1.989
90	2.547
100	3.227
110	4.049
120	5.033
130	6.201
140	7.577
150	9.187
160	11.060
170	13.220
180	15.700
190	18.520
200	21.740
210	25.360

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
50	.01258
60	.01639
70	.02109
80	.02681
90	.03371
100	.04196
110	.05172
120	.06317
130	.07652
140	.09194
150	.10960
160	.12980
170	.15270
180	.17850
190	.20750
200	.23970
210	.27560

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.204
25	.219
50	.234
75	.248
100	.261
125	.275
150	.288
175	.301
200	.313
225	.325
250	.337
275	.349
300	.360
325	.371
350	.381
375	.392
400	.402
425	.412
450	.421
475	.431
500	.440
525	.449
550	.457
575	.465
600	.474

CARBON DISULFIDE

CBB

Common Synonyms	Watery liquid	Colorless to yellow	Rotten egg to sweet odor
Carbon bisulfide	Sinks in water. Flammable, irritating vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical or carbon dioxide.
Water and foam may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access
Evacuate area

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Carbon disulfide
3.2 Formula: CS_2
3.3 IMO/UN Designation: 3.1/1131
3.4 DOT ID No.: 1131
3.5 CAS Registry No.: 75-15-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Faint sweetish; disagreeable; offensive, like that of decaying cabbage

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Only approved self-contained breathing mask with full face is recommended. If the vapor concentration exceeds 2% by volume or is unknown, supplied-air respiratory equipment of appropriate design with full face masks should be used by all persons entering contaminated area. Masks should be used only for emergency situations and should be located accordingly. Almost any type of industrial clothing is satisfactory. Splashes of small quantity are not harmful to fabrics, and evaporation from clothing is quite rapid. Clothing should, however, be removed and the skin washed with water. Goggles should be used when there is any danger of CS_2 splashes or spray.

5.2 Symptoms Following Exposure: ACUTE EXPOSURE: mild to moderate irritation of skin, eyes, and mucous membranes from liquid or concentrated vapors; headache, garlicky breath, nausea, vomiting, diarrhea (even after vapor exposures), and occasionally abdominal pain; weak pulse, palpitations; fatigue, weakness in the legs, unsteady gait, vertigo; mania, hallucinations of sight, hearing, taste, and smell in acute, massive vapor exposures; central nervous depression with respiratory paralysis; death may occur during coma or after a convulsion.

5.3 Treatment of Exposure: INHALATION: remove victim promptly from contaminated area. Administer oxygen and artificial respiration if needed. SKIN CONTACT: wash affected areas with copious quantities of water. INGESTION: induce vomiting and follow with gastric lavage and saline cathartics.

5.4 Threshold Limit Value: 10 ppm

5.5 Short Term Inhalation Limits: 200 ppm for 10 minutes, 100 ppm for 30 minutes and 50 ppm for 60 minutes.

5.6 Toxicity by Ingestion: Grade 2; rat LD_{50} 0.1 - 0.99 g/kg

5.7 Late Toxicity: Non-specific liver cell damage in rats; higher incidence of upper respiratory disease in humans

5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.

(Continued)

6. FIRE HAZARDS

6.1 Flash Point: —22°F C.C.
6.2 Flammable Limits in Air: 1.3%-50%
6.3 Fire Extinguishing Agents: Dry chemical, carbon dioxide, or foam.
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective on fire.
6.5 Special Hazards of Combustion Products: Toxic gases are generated; wear self-contained breathing apparatus.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 212°F
6.8 Electrical Hazard: Contact of the liquid or vapor with the surface of a lighted electric light bulb could result in ignition.
6.9 Burning Rate: 2.7 mm/min.
6.10 Adiabatic Flame Temperature: Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 38

8. WATER POLLUTION

8.1 Aquatic Toxicity: 35 ppm/48 hr/mosquito fish/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial; technical; USP
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: Inerted
9.4 Venting: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid

11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	4
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	3
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 76.14
12.3 Boiling Point at 1 atm: 115°F = 46.3°C = 319.5°K
12.4 Freezing Point: —168.9°F = —111.6°C = 161.6°K
12.5 Critical Temperature: 523°F = 273°C = 546°K
12.6 Critical Pressure: 1100 psia = 76 atm = 7.7 MN/m^2
12.7 Specific Gravity: 1.26 at 20°C (liquid)
12.8 Liquid Surface Tension: 32 dynes/cm = .032 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 48.4 dynes/cm = .0484 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.6
12.11 Ratio of Specific Heats of Vapor (Gas): 1.292
12.12 Latent Heat of Vaporization: 153 Btu/lb = 85 cal/g = 3.559×10^5 J/kg
12.13 Heat of Combustion: —5814 Btu/lb = —3230 cal/g = -135.2×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 13.80 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 10.3 psia

5. HEALTH HAZARDS (Continued)

5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure and may cause secondary burns on long exposure.
5.10 Odor Threshold: 0.21 ppm
5.11 IDLH Value: 500 ppm

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

CARBON DISULFIDE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—30	83.719
—20	83.240
—10	82.750
0	82.270
10	81.780
20	81.299
30	80.809
40	80.320
50	79.841
60	79.349
70	78.870
80	78.379
90	77.900
100	77.410
110	76.929

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
—110	.219
—100	.220
—90	.221
—80	.223
—70	.224
—60	.225
—50	.226
—40	.227
—30	.228
—20	.229
—10	.230
0	.231
10	.233
20	.234
30	.235
40	.236
50	.237
60	.238
70	.239
80	.240
90	.241
100	.243
110	.244

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—110	1.030
—100	1.021
—90	1.012
—80	1.003
—70	.994
—60	.985
—50	.976
—40	.967
—30	.958
—20	.950
—10	.941
0	.932
10	.923
20	.914
30	.905
40	.896
50	.887
60	.878

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
35	.421
40	.412
45	.403
50	.395
55	.387
60	.379
65	.371
70	.364
75	.357
80	.351
85	.344
90	.338
95	.332
100	.326
105	.321
110	.315

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
15	1.595
20	1.821
25	2.074
30	2.356
35	2.670
40	3.017
45	3.402
50	3.826
55	4.294
60	4.808
65	5.372
70	5.990
75	6.665
80	7.402
85	8.204
90	9.076
95	10.020
100	11.050
105	12.160
110	13.360
115	14.650
120	16.040
125	17.540
130	19.150
135	20.870
140	22.720

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
15	.02383
20	.02693
25	.03036
30	.03413
35	.03828
40	.04283
45	.04781
50	.05325
55	.05918
60	.06562
65	.07263
70	.08021
75	.08842
80	.09728
85	.10680
90	.11710
95	.12820
100	.14000
105	.15270
110	.16630
115	.18080
120	.19630
125	.21280
130	.23030
135	.24900
140	.26880

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.110
20	.112
40	.113
60	.115
80	.116
100	.118
120	.119
140	.120
160	.122
180	.123
200	.124
220	.125
240	.127
260	.128
280	.129
300	.130
320	.131
340	.132
360	.133
380	.134
400	.135
420	.136
440	.136

CHLOROFORM

CRF

Common Synonyms	Watery liquid	Colorless	Sweet odor
Trichloromethane	Sinks in water. Irritating vapor is produced.		

Avoid contact with liquid and vapor. Stay upwind.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible. Keep people away.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS AND IRRITATING GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, nausea, dizziness, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS AND HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-air contaminant
Restrict access
Should be removed

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $CHCl_3$
3.3 IMO/UN Designation: 9.0/1888
3.4 DOT ID No.: 1888
3.5 CAS Registry No.: 67-66-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Pleasant, sweet; ethereal

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Chemical goggles, 50 ppm to 2%; suitable full-face gas mask. Above 2%; suitable self-contained system.
5.2 Symptoms Following Exposure: Headache, nausea, dizziness, drunkenness, narcosis.
5.3 Treatment of Exposure: INHALATION: if ill effects develop, get victim to fresh air, keep him warm and quiet, and get medical attention. If breathing stops, start artificial respiration. INGESTION: induce vomiting and get medical attention. No known antidote; treat symptoms. EYES: flush with plenty of water for at least 15 minutes and get medical attention. SKIN: wash with soap and water, remove contaminated clothing and free of chemical.
5.4 Threshold Limit Value: 10 ppm
5.5 Short Term Inhalation Limits: 50 ppm for 10 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 205-307 ppm
5.11 IDLH Value: 1,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Poisonous and irritating gases are produced when heated.
6.6 Behavior in Fire: Decomposes, producing toxic gases
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical, USP
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A

11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 119.39
12.3 Boiling Point at 1 atm: 142°F = 61.2°C = 334.4°K
12.4 Freezing Point: —82.3°F = —63.5°C = 209.7°K
12.5 Critical Temperature: 506°F = 263.2°C = 536.4°K
12.6 Critical Pressure: 790 psia = 54 atm = 5.5 MN/m^2
12.7 Specific Gravity: 1.49 at 20°C (liquid)
12.8 Liquid Surface Tension: 27.1 dynes/cm = 0.0271 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 32.8 dynes/cm = 0.0328 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 4.1
12.11 Ratio of Specific Heats of Vapor (Gas): 1.146
12.12 Latent Heat of Vaporization: 106.7 Btu/lb = 59.3 cal/g = 2.483 X 10^3 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 17.62 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 6.39 psia

NOTES

CHLOROFORM

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—50	100.799
—40	100.200
—30	99.549
—20	98.910
—10	98.259
0	97.610
10	96.950
20	96.299
30	95.639
40	94.980
50	94.320
60	93.650
70	92.990
80	92.320
90	91.650
100	90.980
110	90.309
120	89.629
130	88.950
140	88.270

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.216
10	.217
20	.219
30	.221
40	.222
50	.224
60	.226
70	.227
80	.229
90	.231
100	.232
110	.234
120	.236
130	.237
140	.239

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—70	.938
—60	.929
—50	.920
—40	.911
—30	.902
—20	.893
—10	.884
0	.875
10	.866
20	.857
30	.848
40	.839
50	.830
60	.821
70	.812
80	.804
90	.795
100	.786
110	.777
120	.768
130	.759
140	.750

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	.847
10	.791
20	.741
30	.697
40	.656
50	.620
60	.586
70	.556
80	.528
90	.503
100	.479
110	.458
120	.438
130	.420
140	.403

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.800

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—30	.150
—20	.217
—10	.309
0	.433
10	.598
20	.816
30	1.099
40	1.462
50	1.924
60	2.505
70	3.229
80	4.124
90	5.220
100	6.551
110	8.157
120	10.080

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—30	.00387
—20	.00548
—10	.00763
0	.01047
10	.01417
20	.01892
30	.02496
40	.03255
50	.04198
60	.05361
70	.06781
80	.08499
90	.10560
100	.13020
110	.15930
120	.19340

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.123
25	.126
50	.129
75	.131
100	.134
125	.137
150	.139
175	.142
200	.144
225	.146
250	.148
275	.150
300	.152
325	.154
350	.156
375	.158
400	.160
425	.161
450	.162
475	.164
500	.165
525	.166
550	.167
575	.168
600	.169

ETHYLBENZENE

ETB

Common Synonyms	Liquid	Colorless	Sweet, gasoline-like odor
Phenylethane EB	Floats on water. Flammable, irritating vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic hydrocarbon
3.2 **Formula:** $C_6H_5CH_2CH_3$
3.3 **IMO/UN Designation:** 3.3/1175
3.4 **DOT ID No.:** 1175
3.5 **CAS Registry No.:** 100-41-4

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Aromatic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Self-contained breathing apparatus; safety goggles.
5.2 **Symptoms Following Exposure:** Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters.
5.3 **Treatment of Exposure:** INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 200 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 **Odor Threshold:** 140 ppm
5.11 **IDLH Value:** 2,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 80°F O.C.; 59°F C.C.
6.2 **Flammable Limits in Air:** 1.0%-6.7%
6.3 **Fire Extinguishing Agents:** Foam (most effective), water fog, carbon dioxide or dry chemical.
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Irritating vapors are generated when heated.
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back.
6.7 **Ignition Temperature:** 860°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 5.8 mm/min.
6.10 **Adiabatic Flame Temperature:** Data Not Available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data Not Available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 29 ppm/96 hr/bluegill/TL$_m$/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 2.8% (theor.), 5 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 106.17
12.3 **Boiling Point at 1 atm:** 277.2°F = 136.2°C = 409.4°K
12.4 **Freezing Point:** −139°F = −95°C = 178°K
12.5 **Critical Temperature:** 651.0°F = 343.9°C = 617.1°K
12.6 **Critical Pressure:** 523 psia = 35.6 atm = 3.61 MN/m^2
12.7 **Specific Gravity:** 0.867 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 29.2 dynes/cm = 0.0292 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 35.48 dynes/cm = 0.03548 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.071
12.12 **Latent Heat of Vaporization:** 144 Btu/lb = 80.1 cal/g = 3.35 X 10^5 J/kg
12.13 **Heat of Combustion:** −17,780 Btu/lb = −9677 cal/g = −413.5 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data Not Available
12.26 **Limiting Value:** Data Not Available
12.27 **Reid Vapor Pressure:** 0.4 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data Not Available
6.12 **Flame Temperature:** Data Not Available

ETHYLBENZENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	54.990
50	54.680
60	54.370
70	54.060
80	53.750
90	53.430
100	53.120
110	52.810
120	52.500
130	52.190
140	51.870
150	51.560
160	51.250
170	50.940
180	50.620
190	50.310
200	50.000
210	49.690

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
40	.402
50	.404
60	.407
70	.409
80	.412
90	.414
100	.417
110	.419
120	.421
130	.424
140	.426
150	.429
160	.431
170	.434
180	.436
190	.439
200	.441
210	.443

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—90	1.065
—80	1.056
—70	1.047
—60	1.037
—50	1.028
—40	1.018
—30	1.009
—20	1.000
—10	.990
0	.981
10	.971
20	.962
30	.953
40	.943
50	.934
60	.924
70	.915
80	.906
90	.896
100	.887
110	.877
120	.868
130	.859
140	.849
150	.840
160	.830

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
40	.835
50	.774
60	.719
70	.670
80	.626
90	.586
100	.550
110	.518
120	.488
130	.461
140	.436
150	.414
160	.393
170	.374
180	.356
190	.340
200	.325
210	.311

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.020

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
80	.202
100	.370
120	.644
140	1.071
160	1.713
180	2.643
200	3.953
220	5.747
240	8.147
260	11.290
280	15.320
300	20.410
320	26.730
340	34.460
360	43.800
380	54.950

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
80	.00370
100	.00654
120	.01099
140	.01767
160	.02734
180	.04087
200	.05926
220	.08363
240	.11520
260	.15510
280	.20490
300	.26570
320	.33910
340	.42620
360	.52850
380	.64720

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
—400	—.007
—350	.026
—300	.060
—250	.093
—200	.125
—150	.157
—100	.187
—50	.217
0	.246
50	.274
100	.301
150	.327
200	.353
250	.377
300	.401
350	.424
400	.446
450	.467
500	.487
550	.507
600	.525

GASOLINES: AUTOMOTIVE (<4.23g lead/gal)

GAT

Common Synonyms			
Motor spirit Petrol	Watery liquid	Colorless to pale brown or pink	Gasoline odor

Floats on water. Flammable, irritating vapor is produced.

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, headache, difficult breathing or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea or vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Disperse and flush

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Miscellaneous Hydrocarbon Mixtures
3.2 **Formula:** (Mixture of hydrocarbons)
3.3 **IMO/UN Designation:** 3.1/1203
3.4 **DOT ID No.:** 1203
3.5 **CAS Registry No.:** Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless to brown
4.3 **Odor:** Gasoline

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective goggles, gloves.
5.2 **Symptoms Following Exposure:** Irritation of mucous membranes and stimulation followed by depression of central nervous system. Breathing of vapor may also cause dizziness, headache, and incoordination or, in more severe cases, anesthesia, coma, and respiratory arrest. If liquid enters lungs, it will cause severe irritation, coughing, gagging, pulmonary edema, and, later, signs of bronchopneumonia and pneumonitis. Swallowing may cause irregular heartbeat.
5.3 **Treatment of Exposure:** INHALATION: maintain respiration and administer oxygen; enforce bed rest if liquid is in lungs. INGESTION: do NOT induce vomiting; stomach should be lavaged (by doctor) if appreciable quantity is swallowed. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 **Threshold Limit Value:** 300 ppm
5.5 **Short Term Inhalation Limits:** 500 ppm for 30 mn.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg.
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.25 ppm
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** —36°F C.C.
6.2 **Flammable Limits in Air:** 1.4%-7.4%
6.3 **Fire Extinguishing Agents:** Foam, carbon dioxide, dry chemical
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** None
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 853°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 4 mm/mn.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 33

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 90 ppm/24 hr/juvenile American shad/TL_m/fresh water
91 mg/1/24 hr/juvenile American shad/TL_m/salt water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 8%, 5 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Various octane ratings; military specifications
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** 140—390°F = 60—199°C = 333—472°K
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 0.7321 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 19-23 dynes/cm = 0.019—0.023 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 49-51 dynes/cm = 0.049—0.051 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 3.4
12.11 **Ratio of Specific Heats of Vapor (Gas):** (est.) 1.054
12.12 **Latent Heat of Vaporization:** 130—150 Btu/lb = 71—81 cal/g = 3.0 — 3.4 X 10^5 J/kg
12.13 **Heat of Combustion:** —18,720 Btu/lb = —10,400 cal/g = 435.1 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 7.4 psia

NOTES

AT

GASOLINES: AUTOMOTIVE (<4.23g lead/gal)

12.17 TURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
mperature egrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)	Temperature (degrees F)	Centipoise
45	46.270	10	.459	40	.909	46	.521
50	46.130	15	.462	50	.900	48	.514
55	46.000	20	.464	60	.891	50	.507
60	45.850	25	.467	70	.883	52	.500
65	45.710	30	.470	80	.874	54	.494
70	45.560	35	.472	90	.865	56	.487
75	45.400	40	.475	100	.856	58	.481
80	45.240	45	.478	110	.847	60	.475
85	45.080	50	.480	120	.838	62	.469
90	44.910	55	.483	130	.829	64	.463
95	44.750	60	.486	140	.821	66	.457
100	44.570	65	.488	150	.812	68	.451
105	44.390	70	.491	160	.803	70	.446
110	44.210	75	.494	170	.794	72	.440
115	44.030	80	.496	180	.785	74	.435
		85	.499	190	.776	76	.430
		90	.502			78	.424
		95	.504			80	.419
		100	.507			82	.414
		105	.510			84	.410
						86	.405
						88	.400
						90	.396
						92	.391
						94	.387
						96	.382

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
mperature egrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE		DATA NOT AVAILABLE		NOT PERTINENT		DATA NOT AVAILABLE

1,1-DICHLOROETHANE

DCH

Common Synonyms	Oily liquid	Colorless	Chloroform like ethereal
Ethylidene chloride Ethylidene dichloride Chlorinated hydrochloric ether	Sinks and mixes with water.		

Wear goggles, self-contained breathing apparatus, and rubber overclothing
Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Flammable.
POISONOUS GAS MAY BE PRODUCED IN FIRE OR WHEN HEATED.
Containers may explode in fire.
Wear goggles and self-contained breathing apparatus.
Extinguish with alcohol foam, carbon dioxide, or dry chemical.
Water may be ineffective on fire.

Exposure

CALL FOR MEDICAL AID.

LIQUID
If swallowed may cause nausea, vomiting and faintness.
Irritating to skin and eyes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS have victim drink water or milk and induce vomiting.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability.
Restrict access.
Chemical and physical treatment.

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $C_2H_4Cl_2$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2362
3.5 **CAS Registry No.:** 75-34-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Oily liquid
4.2 **Color:** Colorless
4.3 **Odor:** Chloroform

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** In areas of poor ventilation or high concentration, a self-contained breathing apparatus with full face mask should be worn. Chemical workers goggles, rubber gloves, and protective clothing should be worn.
5.2 **Symptoms Following Exposure:** INHALATION: Irritation of respiratory tract. Salivation, sneezing, coughing, dizziness, nausea, and vomiting. EYES: Irritation, lacrimation, and reddening of conjunctiva. SKIN: Irritation. Prolonged or repeated skin contact can produce a slight burn. INGESTION: Ingestion incidental to industrial handling is not considered to be a problem. Swallowing of substantial amounts could cause nausea, vomiting, faintness, drowsiness, cyanosis, and circulatory failure.
5.3 **Treatment of Exposure:** Call a doctor. INHALATION: Remove from contaminated area; keep warm and quiet. If breathing has stopped, give artificial respiration. Administer oxygen. EYES: Flush with large amounts of water or weak bicarbonate of soda solution. SKIN: Dilute with large amounts of water. Remove contaminated clothing. INGESTION: Attempt to empty stomach; dilute by administering fluids (tap water, soapy water, salt water, or milk).
5.4 **Threshold Limit Value:** 200 ppm.
5.5 **Short Term Inhalation Limits:** 250 ppm.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat).
5.7 **Late Toxicity:** Chronic exposure may cause liver damage and dermatitis. Animal experimentation has shown this compound to be slightly embryo-toxic and to retard fetal development.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 4,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 57°F O.C. = 22°F C.C.
6.2 **Flammable Limits in Air:** 5.6% to 11.4%
6.3 **Fire Extinguishing Agents:** Alcohol foam, water, foam, CO_2, dry chemical, carbon tetrachloride
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** When heated to decomposition emits highly toxic fumes to phosgene.
6.6 **Behavior in Fire:** Explosion hazard
6.7 **Ignition Temperature:** 856°F
6.8 **Electrical Hazard:** Data not available
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Data not available
7.3 **Stability During Transport:** Data not available
7.4 **Neutralizing Agents for Acids and Caustics:** Data not available
7.5 **Polymerization:** Data not available
7.6 **Inhibitor of Polymerization:** lable Data not available
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:**
TL_m (Marine pinperch) 250 to 275 mg/l
24-hour TL_m Brine shrimp: 320 mg/l
24-hour TL_m Pinperch: 160 mg/l
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Percent, 0.05 g/g for 10 days Percent, 0.002 g/g for 5 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Data not available
9.2 **Storage Temperature:** Cool
9.3 **Inert Atmosphere:** Data not available
9.4 **Venting:** Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 98.97
12.3 **Boiling Point at 1 atm:** 135.14°F = 57.3°C = 330.5°K
12.4 **Freezing Point:** —143.32°F = —97.4°C = 175.75°K
12.5 **Critical Temperature:** 502.7°F = 261.5°C = 534.65°K
12.6 **Critical Pressure:** 734.8 psia = 50 atm = 5.065 MN/m^2
12.7 **Specific Gravity:** 1.174 at 20°C
12.8 **Liquid Surface Tension:** 24.75 dynes/cm = 0.02475 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** 3.42
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.136 at 20°C (68°F)
12.12 **Latent Heat of Vaporization:** 131.6 Btu/lb = 73.1 cal/g = 3.06×10^4 J/kg
12.13 **Heat of Combustion:** —4,774 Btu/lb = —2,652 cal/g = -111×10^4 J/kg
12.14 **Heat of Decomposition:** Data not available
12.15 **Heat of Solution:** Data not available
12.16 **Heat of Polymerization:** Data not available
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 7.35 psia

NOTES

DICHLOROETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	75.198
40	74.929
45	74.660
50	74.389
55	74.120
60	73.851
65	73.580
70	73.311
75	73.042
80	72.771
85	72.502

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	DATA NOT AVAILABLE

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
35	.804
40	.799
45	.795
50	.791
55	.786
60	.782
65	.778
70	.773
75	.769
80	.765
85	.760
90	.756
95	.752
100	.747
105	.743
110	.739

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
35	.617
40	.595
45	.574
50	.555
55	.537
60	.520
65	.504
70	.489
75	.475
80	.462
85	.449
90	.437
95	.426
100	.415
105	.405
110	.395
115	.386
120	.377

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68	.500

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—70	—1.334
—60	—1.944
—50	—.555
—40	.835
—30	.225
—20	.386
—10	.996
0	1.607
10	2.217
20	2.827
30	3.438
40	4.048
50	4.658
60	5.269
70	5.879
80	6.489
90	7.100
100	7.710
110	8.321
120	8.931
130	9.541

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—100	.07407
—80	.05000
—60	.02594
—40	.00187
—20	.02219
0	.04626
20	.07032
40	.09439
60	.11845
80	.14252
100	.16658
120	.19065
140	.21471
160	.23878

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	DATA NOT AVAILABLE

TETRACHLOROETHANE

TEC

Common Synonyms	Liquid	Colorless to pale yellow	Sweet odor
1, 1, 2, 2-Tetrachloroethane Acetylene tetrachloride	Sinks in water.		

AVOID CONTACT WITH LIQUID AND VAPOR. KEEP PEOPLE AWAY.
Wear rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
Poisonous gases may be produced when heated.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
Harmful if inhaled.

If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Irritating to skin and eyes.
If swallowed will cause nausea and vomiting.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, air contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $Cl_2CHCHCl_2$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 1702
3.5 CAS Registry No.: 1299-90-7

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless yellowish green
4.3 Odor: Chloroform-like, pleasant; like carbon tetrachloride; mild, sweetish, similar to several other chlorinated hydrocarbons.

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Chemical safety goggles; plastic face shield; air- or oxygen-supplied mask; safety hat with brim; solvent-proof apron; synthetic rubber gloves
5.2 Symptoms Following Exposure: Compound is a powerful narcotic and liver poison; may also cause changes in blood composition and neurological disturbances. Repeated exposure by inhalation can be fatal. Ingestion causes vomiting, diarrhea, severe mucosal injury, liver necrosis, cyanosis, unconsciousness, loss of reflexes, and death. Contact with eyes causes irritation and lachrymation. Can be absorbed through the skin and may produce severe skin lesions.
5.3 Treatment of Exposure: INHALATION: remove victim from exposure; begin artificial respiration if breathing has ceased. INGESTION: induce vomiting; call a physician. EYES: irrigate with water for 15 min. SKIN: remove clothing; wash skin thoroughly with warm water and soap.
5.4 Threshold Limit Value: 1 ppm
5.5 Short Term Inhalation Limits: 10 ppm, 30 min.
5.6 Toxicity by Ingestion: Grade 3; oral LD_{50} = 200 mg/kg (rat)
5.7 Late Toxicity: Liver poisoning, nervous disorders
5.8 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.5 ppm
5.11 IDLH Value: 150 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating hydrogen chloride vapor may form in fire.
6.6 Behavior in Fire: Data not available
6.7 Ignition Temperature: Not pertinent
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: May attack some forms of plastics
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical, 96%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 167.85
12.3 Boiling Point at 1 atm: 295.3°F = 146.3°C = 419.5°K
12.4 Freezing Point: —46.8°F = —43.8°C = 229.4°K
12.5 Critical Temperature: Data not available
12.6 Critical Pressure: Data not available
12.7 Specific Gravity: 1.595 at 20°C (liquid)
12.8 Liquid Surface Tension: 37.85 dynes/cm = 0.03785 N/m at 20°C
12.9 Liquid Water Interfacial Tension: Data not available
12.10 Vapor (Gas) Specific Gravity: 5.79
12.11 Ratio of Specific Heats of Vapor (Gas): 1.090 at 25°C
12.12 Latent Heat of Vaporization: 99.2 Btu/lb = 55.1 cal/g = 2.30 X 10^4 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.5 psia

NOTES

TETRACHLOROETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
34	101.400
36	101.299
38	101.200
40	101.099
42	101.000
44	100.900
46	100.799
48	100.599
50	100.500
52	100.400
54	100.299
56	100.200
58	100.099
60	100.000
62	99.910
64	99.799
66	99.690
68	99.589
70	99.480
72	99.379
74	99.270
76	99.160
78	99.059
80	98.950
82	98.849
84	98.740

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
52	.210
54	.210
56	.210
58	.210
60	.210
62	.210
64	.210
66	.210
68	.210
70	.210
72	.210
74	.210
76	.210
78	.210
80	.210
82	.210
84	.210
86	.210

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
30	.791
40	.784
50	.777
60	.770
70	.763
80	.756
90	.748
100	.741
110	.734
120	.727
130	.720
140	.713
150	.706
160	.699
170	.692
180	.685
190	.678
200	.671

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
34	2.527
36	2.473
38	2.422
40	2.371
42	2.322
44	2.275
46	2.229
48	2.184
50	2.140
52	2.098
54	2.057
56	2.017
58	1.977
60	1.939
62	1.902
64	1.866
66	1.831
68	1.797
70	1.764
72	1.732
74	1.700
76	1.669
78	1.639
80	1.610
82	1.582
84	1.554

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
34	.251
36	.252
38	.254
40	.256
42	.258
44	.259
46	.261
48	.263
50	.265
52	.266
54	.268
56	.270
58	.272
60	.273
62	.275
64	.277
66	.279
68	.280
70	.282
72	.284
74	.286
76	.287
78	.289
80	.291
82	.293
84	.294

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
80	.161
90	.216
100	.285
110	.374
120	.485
130	.624
140	.796
150	1.008
160	1.265
170	1.578
180	1.954
190	2.403
200	2.938
210	3.570
220	4.313
230	5.182
240	6.194
250	7.366
260	8.719
270	10.270
280	12.050
290	14.070

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
80	.00468
90	.00614
100	.00797
110	.01026
120	.01309
130	.01655
140	.02076
150	.02584
160	.03193
170	.03918
180	.04776
190	.05784
200	.06964
210	.08335
220	.09922
230	.11750
240	.13840
250	.16230
260	.18940
270	.22010
280	.25470
290	.29350

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
90	.145
100	.146
110	.148
120	.149
130	.150
140	.151
150	.153
160	.154
170	.155
180	.156
190	.157
200	.159
210	.160
220	.161
230	.162
240	.164
250	.165
260	.166

TRICHLOROETHANE

TCE

Common Synonyms	Watery liquid	Colorless	Sweet odor
1,1,1-Trichloroethane Methylchloroform Aerothene Chlorothene	Sinks in water. Irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Avoid contact with liquid and vapor.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, or foam.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, may produce nausea.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** CH_3CCl_3
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2831
3.5 **CAS Registry No.:** 71-55-6

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Chloroform-like; sweetish

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or polyvinyl-alcohol-type gloves; chemical safety goggles and face shield; neoprene safety shoes (or leather safety shoes plus neoprene footwear); neoprene or polyvinyl alcohol suit or apron for splash protection.
5.2 **Symptoms Following Exposure:** INHALATION: symptoms range from loss of equilibrium and incoordination to loss of consciousness; high concentration can be fatal due to simple asphyxiation combined with loss of consciousness. INGESTION: produces effects similar to inhalation and may cause some feeling of nausea. EYES: slightly irritating and lachrymatory. SKIN: defatting action may cause dermatitis.
5.3 **Treatment of Exposure:** Get medical attention for all eye exposures and any other serious overexposures. Do NOT administer adrenalin or epinephrine; otherwise, treatment is symptomatic. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting. EYES: flush thoroughly with water. SKIN: remove contaminated clothing and wash exposed area thoroughly with soap and warm water.
5.4 **Threshold Limit Value:** 350 ppm
5.5 **Short Term Inhalation Limits:** 1,000 ppm for 60 min. in man
5.6 **Toxicity by Ingestion:** Grade 1; LD_{50} = 5 to 15 g/kg (rat, mouse, rabbit, guinea pig)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 100 ppm
5.11 **IDLH Value:** 1,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** Data not available
6.2 **Flammable Limits in Air:** 7%-16%
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic and irritating gases are generated in fires.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 932°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** (est.) 2.9 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Reacts slowly, releasing corrosive hydrochloric acid.
7.2 **Reactivity with Common Materials:** Corrodes aluminum, but reaction is not hazardous.
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 75-150 ppm/*/pinfish/TL_m/salt water
*Time period not specified.
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Uninhibited; inhibited; industrial inhibited; white room; cold cleaning
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 133.41
12.3 **Boiling Point at 1 atm:** 165°F = 74°C = 347°K
12.4 **Freezing Point:** <—38°F = <—39°C = <234°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.31 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 25.4 dynes/cm = 0.0254 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** (est.) 45 dynes/cm = 0.045 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 4.6
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.104
12.12 **Latent Heat of Vaporization:** 100 Btu/lb = 58 cal/g = 2.4 X 10^4 J/kg
12.13 **Heat of Combustion:** (est.) 4700 Btu/lb = 2600 cal/g = 110 X 10^4 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 4.0 psia

NOTES

TRICHLOROETHANE

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
0	85.419
10	84.870
20	84.309
30	83.759
40	83.200
50	82.650
60	82.089
70	81.540
80	80.981
90	80.429
100	79.870
110	79.320
120	78.759
130	78.209
140	77.650
150	77.099
160	76.540

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
55	.240
60	.242
65	.244
70	.246
75	.248
80	.250
85	.252
90	.254
95	.256
100	.258
105	.260
110	.262
115	.264
120	.266
125	.268
130	.270
135	.272
140	.274

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	NOT PERTINENT

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise
15	1.363
20	1.295
25	1.231
30	1.172
35	1.117
40	1.065
45	1.017
50	.972
55	.929
60	.889
65	.852
70	.817
75	.784
80	.753
85	.723

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.070

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
70	2.099
75	2.364
80	2.657
85	2.980
90	3.335
95	3.725
100	4.152
105	4.619
110	5.130
115	5.686
120	6.292
125	6.950
130	7.663
135	8.437
140	9.273
145	10.180
150	11.150
155	12.200
160	13.330
165	14.540
170	15.840
175	17.240
180	18.730
185	20.330
190	22.030

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
70	.04925
75	.05495
80	.06119
85	.06799
90	.07540
95	.08346
100	.09220
105	.10170
110	.11190
115	.12300
120	.13490
125	.14770
130	.16150
135	.17630
140	.19220
145	.20920
150	.22730
155	.24670
160	.26730
165	.28930
170	.31270
175	.33760
180	.36390
185	.39180
190	.42140

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.146
25	.150
50	.155
75	.159
100	.163
125	.167
150	.171
175	.175
200	.179
225	.183
250	.186
275	.190
300	.193
325	.196
350	.199
375	.202
400	.205
425	.208
450	.210
475	.213
500	.215
525	.217
550	.219
575	.222
600	.223

METHYL ISOBUTYL KETONE

MIK

Common Synonyms	Watery liquid	Colorless	Mild pleasant odor
4-Methyl-2-pentanone Isobutyl methyl ketone MIBK Hexone Isopropylacetone MIK	Floats and mixes slowly with water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Disperse and flush

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Ketone
3.2 **Formula:** $(CH_3)_2CHCH_2COCH_3$
3.3 **IMO/UN Designation:** 3.2/1245
3.4 **DOT ID No.:** 1245
3.5 **CAS Registry No.:** 108-10-1

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Pleasant; mild, characteristic; sharp; non-residual; ketonic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic canister or air pack; rubber gloves; goggles or face shield.
5.2 **Symptoms Following Exposure:** Vapor causes irritation of eyes and nose; high concentrations cause anesthesia and depression. Liquid dries out skin and may cause dermatitis; irritates eyes but does not injure them.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air, give artificial respiration if needed; call a doctor. SKIN OR EYES: wash eyes thoroughly with water; wash skin with water until irritation stops.
5.4 **Threshold Limit Value:** 50 ppm
5.5 **Short Term Inhalation Limits:** 100 ppm for 60 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.47 ppm
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** 73°F C.C.; 75°F O.C.
6.2 **Flammable Limits in Air:** 1.4%-7.5%
6.3 **Fire Extinguishing Agents:** Alcohol foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** Irritating vapors are generated when heated.
6.6 **Behavior in Fire:** Vapors may travel a considerable distance and ignite.
6.7 **Ignition Temperature:** 854°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 18

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** (theor.) 1.8%, 0.5 day; (theor.) 12%, 5 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 99+%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Not listed
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	1
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 100.16
12.3 **Boiling Point at 1 atm:** 241.2°F = 116.2 = 389.4°K
12.4 **Freezing Point:** −119°F = −84°C = 189°K
12.5 **Critical Temperature:** 568.9°F = 298.3°C = 571.5°K
12.6 **Critical Pressure:** 475 psia = 32.3 atm = 3.27 MN/m²
12.7 **Specific Gravity:** 0.802 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 23.6 dynes/cm = 0.0236 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 15.7 dynes/cm = 0.0157 N/m at 22.7°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.061
12.12 **Latent Heat of Vaporization:** 149 Btu/lb = 82.5 cal/g = 3.45 X 10^5 J/kg
12.13 **Heat of Combustion: (est.)** −10,400 Btu/lb = −5,800 cal/g = −242 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** (est.) −9 Btu/lb = −5 cal/g = −0.2 X 10^5 J/kg
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.8 psia

NOTES

MIK	METHYL ISOBUTYL KETONE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	51.150
40	50.990
45	50.830
50	50.660
55	50.500
60	50.340
65	50.170
70	50.010
75	49.850
80	49.680
85	49.520
90	49.360
95	49.200
100	49.030
105	48.870
110	48.710
115	48.540
120	48.380

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
—30	.426
—20	.429
—10	.432
0	.435
10	.438
20	.441
30	.444
40	.447
50	.450
60	.453
70	.457
80	.460
90	.463
100	.466
110	.469
120	.472
130	.475
140	.478
150	.481
160	.484
170	.487
180	.490
190	.493
200	.496
210	.499

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	NOT PERTINENT

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
77.02	3.800

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	2.000

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
40	.109
50	.157
60	.222
70	.308
80	.422
90	.569
100	.757
110	.995
120	1.290
130	1.655
140	2.101
150	2.641
160	3.289
170	4.060
180	4.971
190	6.039
200	7.284
210	8.724
220	10.380
230	12.280
240	14.430
250	16.880
260	19.630
270	22.710
280	26.160
290	29.990

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	.00203
50	.00287
60	.00398
70	.00543
80	.00730
90	.00967
100	.01263
110	.01629
120	.02077
130	.02619
140	.03270
150	.04042
160	.04952
170	.06017
180	.07251
190	.08674
200	.10300
210	.12160
220	.14250
230	.16610
240	.19250
250	.22190
260	.25450
270	.29040
280	.33000
290	.37320

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.306
25	.320
50	.334
75	.348
100	.361
125	.374
150	.387
175	.400
200	.412
225	.424
250	.436
275	.448
300	.460
325	.471
350	.482
375	.493
400	.503
425	.514
450	.524
475	.534
500	.544
525	.553
550	.562
575	.572
600	.581

m-DINITROBENZENE

DNB

Common Synonyms	Solid	Yellow	Slight odor
1, 3-Dinitrobenzene 1, 3-Dinitrobenzol m-DNB meta-Dinitrobenzene Dinitrobenzol	Sinks in water.		

AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
May explode if exposed to heat or flames.

Flood discharge area with water.
Combat fires from behind barrier.

Exposure

CALL FOR MEDICAL AID.

VAPOR OR DUST
POISONOUS IF INHALED OR IF SKIN IS EXPOSED.

Move victim to fresh air.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing is difficult, give oxygen.

SOLID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Poison
2.2 Class: 6

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: 1,3-$C_6H_4(NO_2)_2$
3.3 IMO/UN Designation: 6.1/1597
3.4 DOT ID No.: 1597
3.5 CAS Registry No.: 99-65-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: Yellow
4.3 Odor: Weak

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Dust respirator; rubber gloves; protective clothing.
5.2 Symptoms Following Exposure: Inhalation or ingestion causes loss of color, nausea, headache, dizziness, drowsiness, and collapse. Eyes are irritated by liquid. Stains skin yellow; if contact is prolonged, can be absorbed into blood and cause same symptoms as for inhalation.
5.3 Treatment of Exposure: INHALATION: remove from exposure; get medical attention for methemoglobinemia. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water. INGESTION: induce vomiting, if conscious; give gastric lavage and saline cathartic; get medical attention.
5.4 Threshold Limit Value: 0.15 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 4; oral LD_{50} = 42 mg/kg (bird)
5.7 Late Toxicity: May cause liver damage, anemia, neuritis.
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 200 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: Not pertinent (combustible solid)
6.2 Flammable Limits in Air: Not pertinent
6.3 Fire Extinguishing Agents: Water from protected location
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: May explode
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: 8-10 mg/l/6 hr/minnows/min. lethal dose/ fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Poison, B
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 168.1
12.3 Boiling Point at 1 atm: 556°F = 291°C = 564°K
12.4 Freezing Point: 194°F = 90°C = 363°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.58 at 18°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: −7,378 Btu/lb = −4,099 cal/g = −171.5 X 10^3 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 24.70 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

m-DINITROBENZENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	.001		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT
36	.001						
38	.002						
40	.002						
42	.003						
44	.003						
46	.004						
48	.004						
50	.005						
52	.006						
54	.006						
56	.007						
58	.007						
60	.008						
62	.008						
64	.009						
66	.009						
68	.010						
70	.011						
72	.011						
74	.012						
76	.012						
78	.013						
80	.013						
82	.014						
84	.014						

2,4-DINITROTOLUENE

DTT

Common Synonyms	Solid or heated liquid	Yellow to red solid or yellow liquid	Slight odor
DNT 2, 4-Dinitrotoluol 1-Methyl-2, 4-Dinitrobenzene	Liquid solidifies. Solid and liquid sink in water.		

AVOID CONTACT WITH LIQUID AND SOLID. KEEP PEOPLE AWAY.
Wear rubber overclothing (including gloves).
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Containers may explode in fire.
Wear goggles and self-contained breathing appartus.
Extinguish with water, dry chemicals, foam, or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID OR SOLID
POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED.
Will burn skin and eyes.
If swallowed will cause nausea, vomiting or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison, water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** 2, 4-$(NO_2)_2C_6H_3CH_3$
3.3 **IMO/UN Designation:** Solid: 6.1/2038; liquid: 6.1/1600
3.4 **DOT ID No.:** 1600 (Liquid); 2038 (Solid)
3.5 **CAS Registry No.:** 121-14-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Solid or liquid
4.2 **Color:** Yellow (liquid); yellow to red (solid)
4.3 **Odor:** Weak

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Air-line mask or self-contained breathing apparatus; safety goggles and face shield; rubber gloves and boots; protective clothing.
5.2 **Symptoms Following Exposure:** Ingestion or overexposure to vapors from hot liquid can cause loss of color, nausea, headache, dizziness, drowsiness, collapse. Hot liquid can burn eyes and skin. Prolonged skin contact with solid can give same symptoms as after inhalation or ingestion.
5.3 **Treatment of Exposure:** INHALATION: remove victim from exposure; get medical attention for methemoglobinemia. EYES: flush with copious amounts of water and get medical attention. SKIN: wash well with soap and water. INGESTION: induce vomiting, if victim is conscious; give gastric lavage and saline cathartic; get medical attention.
5.4 **Threshold Limit Value:** 1.5 mg/m³
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 4; oral LD_{50} = 30 mg/kg (rat)
5.7 **Late Toxicity:** May cause liver damage, anemia, neuritis.
5.8 **Vapor (Gas) Irritant Characteristics:** Not pertinent
5.9 **Liquid or Solid Irritant Characteristics:** Data not available
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 200 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** 404°F C.C.
6.2 **Flammable Limits in Air:** Not pertinent
6.3 **Fire Extinguishing Agents:** Water, dry chemical, carbon dioxide from protected location
6.4 **Fire Extinguishing Agents Not to be Used:** Data not available
6.5 **Special Hazards of Combustion Products:** Nitrogen oxides and dense black smoke are produced in a fire.
6.6 **Behavior in Fire:** Decomposition is self-sustaining at 280°C. Containers may explode in a fire.
6.7 **Ignition Temperature:** Not pertinent
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable below 482°F (250°C)
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical. Mixtures such as an 80:20 mixture of 2, 4- and 2, 6-isomers are also available. The hazard properties are similar.
9.2 **Storage Temperature:** Ambient (solid); >90°C (liquid)
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y-II

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-E
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	1
Reactivity (Yellow)	3

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Solid
12.2 **Molecular Weight:** 182.1
12.3 **Boiling Point at 1 atm:** Decomposes
12.4 **Freezing Point:** 158°F = 70°C = 343°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.379 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** 170 Btu/lb = 93 cal/g = 3.9×10^5 J/kg
12.13 **Heat of Combustion:** −8,305 Btu/lb = −4,614 cal/g = -193.0×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 26.40 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

DTT

2,4-DINITROTOLUENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT	211.73	.349		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	.02		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT
36	.022						
38	.022						
40	.022						
42	.022						
44	.023						
46	.023						
48	.023						
50	.024						
52	.024						
54	.024						
56	.024						
58	.025						
60	.025						
62	.025						
64	.026						
66	.026						
68	.026						
70	.026						
72	.027						
74	.027						
76	.027						
78	.028						
80	.028						
82	.028						
84	.029						

m-XYLENE

XLM

Common Synonyms	Watery liquid	Colorless	Sweet odor
1, 3-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, or loss of consciousness.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** m-$C_6H_4(CH_3)_2$
3.3 **IMO/UN Designation:** 3.2/1307
3.4 **DOT ID No.:** 1307
3.5 **CAS Registry No.:** 108-38-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Like benzene; characteristic aromatic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 **Symptoms Following Exposure:** Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 300 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 g/kg
5.7 **Late Toxicity:** Kidney and liver damage.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.05 ppm
5.11 **IDLH Value:** 10,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 84°F C.C.
6.2 **Flammable Limits in Air:** 1.1%-6.4%
6.3 **Fire Extinguishing Agents:** Foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 986°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.8 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0 lb/lb, 5 days; 0% (theor.), 8 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research: 99.99%; Pure: 99.9%; Technical: 99.2%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 106.16
12.3 **Boiling Point at 1 atm:** 269.4°F = 131.9°C = 405.1°K
12.4 **Freezing Point:** —54.2°F = —47.9°C = 225.3°K
12.5 **Critical Temperature:** 650.8°F = 343.8°C = 617.0°K
12.6 **Critical Pressure:** 513.6 atm = 34.95 psia = 3.540 MN/m^2
12.7 **Specific Gravity:** 0.864 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 28.6 dynes/cm = 0.0286 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 36.4 dynes/cm = 0.0364 N/m at 30°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.071
12.12 **Latent Heat of Vaporization:** 147 Btu/lb = 81.9 cal/g = 3.43 X 10^5 J/kg
12.13 **Heat of Combustion:** —17,554 Btu/lb = —9752.4 cal/g = —408.31 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 26.01 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.34 psia

NOTES

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
15	55.400	40	.387	35	.962	15	.938
20	55.260	50	.393	40	.953	20	.898
25	55.130	60	.398	45	.944	25	.862
30	54.990	70	.404	50	.935	30	.827
35	54.850	80	.410	55	.926	35	.794
40	54.710	90	.415	60	.917	40	.764
45	54.570	100	.421	65	.908	45	.735
50	54.430	110	.426	70	.899	50	.708
55	54.290	120	.432	75	.890	55	.682
60	54.160	130	.437	80	.881	60	.658
65	54.020	140	.443	85	.873	65	.635
70	53.880	150	.448	90	.864	70	.613
75	53.740	160	.454	95	.855	75	.592
80	53.600	170	.460	100	.846	80	.572
85	53.460	180	.465			85	.554
90	53.320	190	.471				
95	53.180	200	.476				
100	53.050	210	.482				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	.090	60	.00172	0	.247
	N	70	.127	70	.00238	25	.260
	S	80	.177	80	.00324	50	.273
	O	90	.242	90	.00435	75	.286
	L	100	.326	100	.00577	100	.299
	U	110	.434	110	.00754	125	.311
	B	120	.571	120	.00975	150	.324
	L	130	.743	130	.01247	175	.336
	E	140	.956	140	.01577	200	.348
		150	1.219	150	.01977	225	.360
		160	1.538	160	.02455	250	.371
		170	1.924	170	.03023	275	.383
		180	2.388	180	.03691	300	.394
		190	2.939	190	.04473	325	.406
		200	3.590	200	.05382	350	.417
		210	4.355	210	.06431	375	.427
		220	5.247	220	.07635	400	.438
		230	6.282	230	.09009	425	.449
		240	7.476	240	.10570	450	.459
		250	8.846	250	.12330	475	.469
		260	10.410	260	.14310	500	.479
						525	.489
						550	.499
						575	.508
						600	.517

OILS, FUEL: 1-D

OOD

Common Synonyms	Oily liquid	Yellow-brown	Lube or fuel oil odor
Diesel oil (light)	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.1/1270
3.4 DOT ID No.: 1270
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Light brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INHALATION causes headache and slight giddiness. INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.
5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting; seek medical attention. ASPIRATION: enforce bed rest; administer oxygen. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water.
5.4 Threshold Limit Value: No single value applicable.
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5-15 g/kg
5.7 Lase Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 Odor Threshold: 0.7 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 100°F C.C.
6.2 Flammable Limits in Air: 1.3%-6%
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 350—625°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available.
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 204 mg/1/24 hr/juvenile American shad/TL_m/salt water
8.2 Waterfowl Toxicity: 20 mg/kg LD_{50} (mallard)
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Diesel fuel 1-D (ASTM)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 360—560°F = 193—293°C = 466—566°K
12.4 Freezing Point: —30°F = —34°C = 240°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.81—0.85 at 15°C (liquid)
12.8 Liquid Surface Tension: 23—32 dynes/cm = 0.023—0.032 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 47—49 dynes/cm = 0.047—0.049 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: 110 Btu/lb = 60 cal/g = 2.5×10^5 J/kg
12.13 Heat of Combustion: —18,540 Btu/lb = —10,300 cal/g = -431.24×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, FUEL: 1-D

12.17 SATURATED LIQUID DENSITY

emperature degrees F)	Pounds per cubic foot
34	51.430
36	51.360
38	51.290
40	51.220
42	51.150
44	51.080
46	51.010
48	50.940
50	50.870
52	50.800
54	50.740
56	50.670
58	50.600
60	50.530
62	50.460
64	50.390
66	50.320
68	50.250
70	50.180
72	50.110
74	50.040
76	49.970
78	49.900
80	49.830
82	49.760
84	49.690

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
70	.469
75	.471
80	.474
85	.476
90	.479
95	.481
100	.484
105	.486
110	.489
115	.491
120	.494
125	.496
130	.499
135	.501
140	.504
145	.506
150	.509
155	.511
160	.514
165	.516
170	.519
175	.521
180	.524
185	.526
190	.529
195	.531

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
50	.964
60	.964
70	.964
80	.964
90	.964
100	.964
110	.964
120	.964
130	.964
140	.964
150	.964
160	.964
170	.964
180	.964
190	.964
200	.964

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
—30	6.065
—25	5.482
—20	4.965
—15	4.508
—10	4.101
—5	3.739
0	3.416
5	3.127
10	2.867
15	2.634
20	2.424
25	2.235
30	2.064
35	1.909
40	1.768
45	1.641
50	1.525
55	1.419
60	1.322
65	1.233
70	1.152
75	1.078

12.21 SOLUBILITY IN WATER

emperature degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
70	.041
80	.056
90	.075
100	.099
110	.130
120	.168
130	.217
140	.277
150	.350
160	.440
170	.548
180	.679
190	.835
200	1.021
210	1.241
220	1.500
230	1.802
240	2.154
250	2.562
260	3.033
270	3.573
280	4.192
290	4.896
300	5.695

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, FUEL: 2

OTW

Common Synonyms	Oily liquid	Yellow-brown	Lube or fuel oil odor
Home-heating oil	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Light brown
4.3 Odor: Like kerosine; characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INHALATION causes headache and slight giddiness. INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.
5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting. ASPIRATION: enforce bed rest; administer oxygen; seek medical attention. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water.
5.4 Threshold Limit Value: No single value applicable.
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1: LD_{50} = 5-15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 136°F C.C.
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 494°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 200 ppm/24 hr/juvenile American shad/TL_m/fresh water
20 ppm/96 hr/rainbow trout eggs/TL_m/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 540—640°F = 282—336°C = 555—611°K
12.4 Freezing Point: —20°F = —29°C = 244°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.879 at 20°C (liquid)
12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: —19,440 Btu/lb = —10,800 cal/g = —452.17 X 10^3 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, FUEL: 2

12.17 SATURATED LIQUID DENSITY

emperature degrees F)	Pounds per cubic foot (estimate)
50	54.740
52	54.740
54	54.740
56	54.740
58	54.740
60	54.740
62	54.740
64	54.740
66	54.740
68	54.740
70	54.740
72	54.740
74	54.740
76	54.740
78	54.740
80	54.740
82	54.740
84	54.740

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
30	.429
35	.431
40	.434
45	.436
50	.439
55	.441
60	.443
65	.446
70	.448
75	.451
80	.453
85	.456
90	.458
95	.460
100	.463
105	.465
110	.468
115	.470
120	.472
125	.475
130	.477

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
30	.908
35	.908
40	.908
45	.908
50	.908
55	.908
60	.908
65	.908
70	.908
75	.908
80	.908
85	.908
90	.908
95	.908
100	.908
105	.908
110	.908
115	.908
120	.908
125	.908
130	.908

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	3.773
10	3.397
20	3.071
30	2.788
40	2.541
50	2.324
60	2.134
70	1.965
80	1.815
90	1.681
100	1.561
110	1.454
120	1.358
130	1.270
140	1.191
150	1.120
160	1.054
170	.995
180	.940
190	.890
200	.844
210	.802

12.21 SOLUBILITY IN WATER

:mperature :egrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
55	.466
60	.474
65	.481
70	.489
75	.497
80	.505
85	.512
90	.520
95	.528
100	.535
105	.543
110	.550
115	.558
120	.565
125	.573
130	.580

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

OILS, FUEL: 2-D

OTD

Common Synonyms	Oily liquid	Yellow-brown	Lube or fuel oil odor
Diesel oil, medium	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam, carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED, and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shorelins.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.1/1270
3.4 DOT ID No.: 1270
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Light brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.
5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting. ASPIRATION: enforce bed rest; administer oxygen; seek medical attention. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water.
5.4 Threshold Limit Value: No single TLV applicable.
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{oo} = 5-15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 125°F C.C.
6.2 Flammable Limits in Air: 1.3%-6.0%
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 490—545°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 204 mg/l/24 hr/juvenile American shad/TL$_m$/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Diesel fuel 2-D (ASTM)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame-arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 540—640°F = 282—338°C = 555—611°K
12.4 Freezing Point: 0°F = 18°C = 255°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.87—0.90 at 20°C (liquid)
12.8 Liquid Surface Tension: Data not available
12.9 Liquid Water Interfacial Tension: Data not available
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: —19,440 Btu/lb = —10,800 cal/g = —452.17 X 10^6 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, FUEL: 2-D

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	54.310
52	54.310
54	54.310
56	54.310
58	54.310
60	54.310
62	54.310
64	54.310
66	54.310
68	54.310
70	54.310
72	54.310
74	54.310
76	54.310
78	54.310
80	54.310
82	54.310
84	54.310

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.414
5	.416
10	.419
15	.421
20	.424
25	.426
30	.428
35	.431
40	.433
45	.436
50	.438
55	.440
60	.443
65	.445
70	.448
75	.450
80	.452
85	.455
90	.457
95	.460
100	.462

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
35	.908
40	.908
45	.908
50	.908
55	.908
60	.908
65	.908
70	.908
75	.908
80	.908
85	.908
90	.908
95	.908
100	.908
105	.908
110	.908
115	.908
120	.908
125	.908

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	3.773
10	3.397
20	3.071
30	2.788
40	2.541
50	2.324
60	2.134
70	1.965
80	1.815
90	1.681
100	1.561
110	1.454
120	1.358
130	1.270
140	1.191
150	1.120
160	1.054
170	.995
180	.940
190	.890
200	.844
210	.802

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
55	.456
60	.474
65	.492
70	.510
75	.529
80	.548
85	.567
90	.587
95	.607
100	.627
105	.647
110	.668
115	.689
120	.711
125	.732
130	.754

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, FUEL: 4

OFR

Common Synonyms	Oily liquid	Dark	Lube or fuel oil odor
Residual fuel oil No. 4	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.

Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.
LIQUID
Irritating to skin and eyes.
Harmful if swallowed.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Miscellaneous Hydrocarbon Mixtures
3.2 **Formula:** Not applicable
3.3 **IMO/UN Designation:** 3.3/1223
3.4 **DOT ID No.:** 1223
3.5 **CAS Registry No.:** Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Brown
4.3 **Odor:** Characteristic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Protective gloves; goggles or face shield.
5.2 **Symptoms Following Exposure:** INGESTION: gastrointestinal irritation. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 **Treatment of Exposure:** INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays; consider prophylactic antibiotic regime if condition warrants. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 **Threshold Limit Value:** Data not available
5.5 **Short Term Inhalation Limits:** Not pertinent
5.6 **Toxicity by Ingestion:** Grade 1: LD_{50} = 5 to 15 g/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** None
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** >130°F C.C.
6.2 **Flammable Limits in Air:** 1.0%-5%
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 505°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 4 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 33

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Commercial
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

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11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Combustible liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** 214 to >1092°F = 101 to >588°C = 374 to 861°K
12.4 **Freezing Point:** −20 to +15°F = −29 to −9°C = 244 to 264°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 0.904 at 15°C (liquid)
12.8 **Liquid Surface Tension:** Data not available
12.9 **Liquid Water Interfacial Tension:** Data not available
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** −17,460 Btu/lb = −9,700 cal/g = -406.1×10^3 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

OILS, FUEL: 4

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	56.180
52	56.180
54	56.180
56	56.180
58	56.180
60	56.180
62	56.180
64	56.180
66	56.180
68	56.180
70	56.180
72	56.180
74	56.180
76	56.180
78	56.180
80	56.180
82	56.180
84	56.180

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
50	.460
52	.461
54	.462
56	.463
58	.464
60	.465
62	.466
64	.467
66	.468
68	.469
70	.470
72	.471
74	.472
76	.473
78	.474
80	.475
82	.476
84	.477
86	.478
88	.479
90	.480
92	.481
94	.482
96	.483
98	.484
100	.485

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
35	.908
40	.908
45	.908
50	.908
55	.908
60	.908
65	.908
70	.908
75	.908
80	.908
85	.908
90	.908
95	.908
100	.908
105	.908
110	.908
115	.908
120	.908
125	.908

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
100.42	14.500

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch (estimate)
70	.042
75	.049
80	.057
85	.065
90	.076
95	.087
100	.100
105	.114
110	.131
115	.149
120	.170
125	.193
130	.218
135	.247
140	.279
145	.314
150	.352
155	.395
160	.443
165	.495
170	.552
175	.615
180	.683
185	.758
190	.841
195	.930

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, FUEL: 5

OFV

Common Synonyms	Oily liquid	Dark	Strong lube oil odor
Residual fuel oil No. 5	Usually floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.

Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION: gastrointestinal irritation. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays; consider prophylactic antibiotic regime if condition warrants. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.3 Treatment of Exposure: Data not available
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Not pertinent
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: None
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: >130°F C.C.
6.2 Flammable Limits in Air: 1%-5%
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Fuel oil No. 5 (heavy); Fuel oil No. 5 (light)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 426—>1062°F = 218—>570°C = 491—>843°K
12.4 Freezing Point: 0°F = —18°C = 255°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: (liquid) 0.936 at 16°C
12.8 Liquid Surface Tension: Data not available
12.9 Liquid Water Interfacial Tension: Data not available
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: —18,000 Btu/lb = —10,000 cal/g = —418.68 X 10^3 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, FUEL: 5

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	58.360
52	58.360
54	58.360
56	58.360
58	58.360
60	58.360
62	58.360
64	58.360
66	58.360
68	58.360
70	58.360
72	58.360
74	58.360
76	58.360
78	58.360
80	58.360
82	58.360
84	58.360

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
50	.460
52	.461
54	.462
56	.463
58	.464
60	.465
62	.466
64	.467
66	.468
68	.469
70	.470
72	.471
74	.472
76	.473
78	.474
80	.475
82	.476
84	.477
86	.478
88	.479
90	.480
92	.481
94	.482
96	.483
98	.484
100	.485

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
40	.873
45	.873
50	.873
55	.873
60	.873
65	.873
70	.873
75	.873
80	.873
85	.873
90	.873
95	.873
100	.873
105	.873

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
100.42	43.500

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch (estimate)
70	.042
75	.049
80	.057
85	.065
90	.076
95	.087
100	.100
105	.114
110	.131
115	.149
120	.170
125	.193
130	.218
135	.247
140	.279
145	.314
150	.352
155	.395
160	.443
165	.495
170	.552
175	.615
180	.683
185	.758
190	.841
195	.930

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, FUEL: NO. 1

OON

Common Synonyms	Watery liquid	Colorless	Kerosene odor
Kerosene Kerosine Range oil JP-1	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to light brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION causes irritation of gastrointestinal tract; pulmonary tract irritation secondary to exhalation of vapors. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema, signs of bronchopneumonia and pneumonitis appear later; minimal central nervous system depression.
5.3 Treatment of Exposure: INGESTION: do NOT lavage or induce vomiting; call physician. ASPIRATION: enforce bed rest; administer oxygen; call physician. EYES: wash with plenty of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5-15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 1 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 100°F C.C.
6.2 Flammable Limits in Air: 0.7%-5%
6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 444°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 2990 ppm/24 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 53%, 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Light hydrocarbon distillate: 100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

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11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	2
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 380 560°F = 193—293°C = 466—566°K
12.4 Freezing Point: —45 to —55°F = —43 to —48°C = 230 to 225°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: (liquid) 0.81 0.85 at 15°C
12.8 Liquid Surface Tension: 23 32 dynes/cm = 0.023—0.032 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 47—49 dynes/cm = 0.047 0.049 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: 110 Btu/lb = 60 cal/g = 2.5 X 10^5 J/kg
12.13 Heat of Combustion: —18,540 Btu/lb = —10,300 cal/g = —431.24 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, FUEL: NO. 1

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
34	51.430	70	.469	0	.926	—35	6.727
36	51.360	75	.471	10	.924	—30	6.065
38	51.290	80	.474	20	.921	—25	5.482
40	51.220	85	.476	30	.919	—20	4.965
42	51.150	90	.479	40	.917	—15	4.508
44	51.080	95	.481	50	.915	—10	4.101
46	51.010	100	.484	60	.913	—5	3.739
48	50.940	105	.486	70	.911	0	3.416
50	50.870	110	.489	80	.909	5	3.127
52	50.800	115	.491	90	.907	10	2.867
54	50.740	120	.494	100	.905	15	2.634
56	50.670	125	.496	110	.903	20	2.424
58	50.600	130	.499	120	.901	25	2.235
60	50.530	135	.501	130	.899	30	2.064
62	50.460	140	.504	140	.897	35	1.909
64	50.390	145	.506	150	.895	40	1.768
66	50.320	150	.509	160	.893	45	1.641
68	50.250	155	.511	170	.891	50	1.525
70	50.180	160	.514	180	.889	55	1.419
72	50.110	165	.516	190	.887	60	1.322
74	50.040	170	.519	200	.885	65	1.233
76	49.970	175	.521	210	.883	70	1.152
78	49.900	180	.524			75	1.078
80	49.830	185	.526				
82	49.760	190	.529				
84	49.690	195	.531				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE	70	.041		NOT PERTINENT		NOT PERTINENT
		80	.056				
		90	.075				
		100	.099				
		110	.130				
		120	.168				
		130	.217				
		140	.277				
		150	.350				
		160	.440				
		170	.548				
		180	.679				
		190	.835				
		200	1.021				
		210	1.241				
		220	1.500				
		230	1.802				
		240	2.154				
		250	2.562				
		260	3.033				
		270	3.573				
		280	4.192				
		290	4.896				
		300	5.695				

OILS, FUEL: No. 6

OSX

Common Synonyms	Thick heated liquid	Black	Tar odor
Bunker C oil Residual fuel oil No. 6	Usually floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon mixture
3.2 Formula: Not listed
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Heated liquid
4.2 Color: Dark
4.3 Odor: Tarry; like kerosene

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION: gastrointestinal irritation. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 Treatment of Exposure: INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays; consider prophylactic antibiotic regime if condition warrants. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Not pertinent
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: None
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: >150°F C.C.
6.2 Flammable Limits in Air: 1%-5%
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 765°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity:
2400 ppm/48 hr/juvenile American shad/TL_m/fresh water
2417 mg/l/48 hr/juvenile American shad/TL_m/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
9.2 Storage Temperature: Elevated
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm:
415—>>1093°F
= 212—>>588°C = 485—>>861°K
12.4 Freezing Point:
25 to 55°F
= —4 to +13°C = 269 to 286°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity:
0.95 (approx.) at 20°C (liquid)
12.8 Liquid Surface Tension: (est.)
25 dynes/cm = 0.025 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.)
50 dynes/cm = 0.05 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity:
Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas):
Not pertinent
12.12 Latent Heat of Vaporization:
Not pertinent
12.13 Heat of Combustion: —18,000 Btu/lb = —10,000 cal/g = —418.68 X 10^4 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, FUEL: 6

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot (estimate)
50	60.300
52	60.300
54	60.300
56	60.300
58	60.300
60	60.300
62	60.300
64	60.300
66	60.300
68	60.300
70	60.300
72	60.300
74	60.300
76	60.300
78	60.300
80	60.300
82	60.300
84	60.300

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
50	.460
52	.461
54	.462
56	.463
58	.464
60	.465
62	.466
64	.467
66	.468
68	.469
70	.470
72	.471
74	.472
76	.473
78	.474
80	.475
82	.476
84	.477
86	.478
88	.479
90	.480
92	.481
94	.482
96	.483
98	.484
100	.485

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
40	.846
45	.846
50	.846
55	.846
60	.846
65	.846
70	.846
75	.846
80	.846
85	.846
90	.846
95	.846
100	.846
105	.846

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
100.42	493.500

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	INSOLUBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch (estimate)
70	.042
75	.049
80	.057
85	.065
90	.076
95	.087
100	.100
105	.114
110	.131
115	.149
120	.170
125	.193
130	.218
135	.247
140	.279
145	.314
150	.352
155	.395
160	.443
165	.495
170	.552
175	.615
180	.683
185	.758
190	.841
195	.930

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

OILS, MISCELLANEOUS: LUBRICATING

OLB

Common Synonyms	Oily liquid	Yellow-brown	Lube oil odor
Crankcase oil Transmission oil Motor oil	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1270
3.4 DOT ID No.: 1270
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Yellow fluorescent
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION: minimal gastrointestinal tract irritation; increased frequency of bowel passage may occur. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 Treatment of Exposure: INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 300°F C.C.
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water or foam may cause frothing.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 500°F-700°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Various viscosities
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Not listed
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: (est.) 0.902 at 20°C (liquid)
12.8 Liquid Surface Tension: 35–37.5 dynes/cm = 0.035–0.037 N/m at 20°C
12.9 Liquid-Water Interfacial Tension: 35–45 dynes/cm = 0.033–0.054 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: −18,486 Btu/lb = −10.7*6 cal/g = −429.98 X 10^4 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

OILS, MISCELLANEOUS: LUBRICATING

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
nperature egrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F (estimate)	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F (estimate)	Temperature (degrees F)	Centipoise
50	56.180	50	.460	35	.920	100.42	275.000
52	56.180	52	.461	40	.919		
54	56.180	54	.462	45	.918		
56	56.180	56	.463	50	.917		
58	56.180	58	.464	55	.916		
60	56.180	60	.465	60	.915		
62	56.180	62	.466	65	.914		
64	56.180	64	.467	70	.913		
66	56.[illegible]90	66	.468	75	.912		
68	56.[illegible]30	68	.469	80	.911		
70	56.180	70	.470	85	.910		
72	56.180	72	.471	90	.909		
74	56.180	74	.472	95	.908		
76	56.180	76	.473	100	.907		
78	56.180	78	.474	105	.906		
80	56.180	80	.475	110	.905		
82	56.180	82	.476	115	.904		
84	56.180	84	.477	120	.903		
		86	.478				
		88	.479				
		90	.480				
		92	.481				
		94	.482				
		96	.483				
		98	.484				
		100	.485				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
nperature grees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch (estimate)	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	70	.042		N		N
	N	75	.049		O		O
	S	80	.057		T		T
	O	85	.065				
	L	90	.076		P		P
	U	95	.087		E		E
	B	100	.100		R		R
	L	105	.114		T		T
	E	110	.131		I		I
		115	.149		N		N
		120	.170		E		E
		125	.193		N		N
		130	.218		T		T
		135	.247				
		140	.279				
		145	.314				
		150	.352				
		155	.395				
		160	.443				
		165	.495				
		170	.552				
		175	.615				
		180	.683				
		185	.758				
		190	.841				
		195	.930				

o-XYLENE

XLO

Common Synonyms
1, 2-Dimethylbenzene
Xylol

Watery liquid | Colorless | Sweet odor

Floats on water. Flammable, irritating vapor is produced.

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** o-$C_6H_4(CH_3)_2$
3.3 **IMO/UN Designation:** 3.2/1307
3.4 **DOT ID No.:** 1307
3.5 **CAS Registry No.:** 95-47-6

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Benzene-like; characteristic aromatic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 **Symptoms Following Exposure:** Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 300 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Kidney and liver damage.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.05 ppm
5.11 **IDLH Value:** 10,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 63°F C.C.; 75°F O.C.
6.2 **Flammable Limits in Air:** 1.1%-7.0%
6.3 **Fire Extinguishing Agents:** Foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 869°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.8 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** >100 mg/l/96 hr/D. magna/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0 lb/lb, 5 days; 2.5% (theor.), 8 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research: 99.99%; Pure: 99.7%; Commercial: 95+%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No reaction
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 106.16
12.3 **Boiling Point at 1 atm:** 291.9°F = 144.4°C = 417.6°K
12.4 **Freezing Point:** —13.3°F = —25.2°C = 248.0°K
12.5 **Critical Temperature:** 674.8°F = 357.1°C = 630.3°K
12.6 **Critical Pressure:** 541.5 atm = 36.84 psia = 3.732 MN/m^2
12.7 **Specific Gravity:** 0.880 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 30.53 dynes/cm = 0.03053 N/m at 15.5°C
12.9 **Liquid Water Interfacial Tension:** 36.06 dynes/cm = 0.03606 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.068
12.12 **Latent Heat of Vaporization:** 149 Btu/lb = 82.9 cal/g = 3.47×10^5 J/kg
12.13 **Heat of Combustion:** —17,558 Btu/lb = —9754.7 cal/g = -408.41×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 30.64 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.26 psia

NOTES

o-XYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
15	56.460
20	56.330
25	56.190
30	56.050
35	55.910
40	55.770
45	55.630
50	55.490
55	55.360
60	55.220
65	55.080
70	54.940
75	54.800
80	54.660
85	54.520
90	54.380
95	54.250
100	54.110

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.389
40	.391
45	.394
50	.396
55	.398
60	.400
65	.402
70	.404
75	.406
80	.408
85	.411
90	.413
95	.415
100	.417

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
35	1.043
40	1.035
45	1.027
50	1.018
55	1.010
60	1.002
65	.993
70	.985
75	.977
80	.969
85	.960
90	.952
95	.944
100	.935

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
15	1.328
20	1.263
25	1.202
30	1.145
35	1.092
40	1.042
45	.995
50	.952
55	.911
60	.873
65	.836
70	.802
75	.770
80	.740
85	.712

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
60	.071
70	.101
80	.141
90	.194
100	.263
110	.352
120	.465
130	.609
140	.787
150	1.007
160	1.277
170	1.605
180	1.999
190	2.469
200	3.028
210	3.686
220	4.456
230	5.352
240	6.389
250	7.581
260	8.947

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	.00135
70	.00188
80	.00258
90	.00349
100	.00464
110	.00611
120	.00794
130	.01021
140	.01298
150	.01634
160	.02038
170	.02520
180	.03090
190	.03759
200	.04539
210	.05443
220	.06484
230	.07674
240	.09030
250	.10560
260	.12290

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.261
25	.274
50	.287
75	.299
100	.311
125	.323
150	.335
175	.347
200	.358
225	.370
250	.381
275	.392
300	.403
325	.414
350	.424
375	.435
400	.445
425	.455
450	.465
475	.475
500	.485
525	.494
550	.504
575	.513
600	.522

OHS19160

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000

CAS NUMBER: 65997-15-1
RTECS NUMBER: VV8770000

SUBSTANCE: PORTLAND CEMENT

TRADE NAMES/SYNONYMS:
HYDRAULIC CEMENT; CEMENT; CEMENT (PORTLAND); SILICATE, PORTLAND CEMENT; PORTLAND CEMENT SILICATE; OHS19160

CREATION DATE: 05/08/86 REVISION DATE: 07/14/93

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : PORTLAND CEMENT
CAS NUMBER: 65997-15-1
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=U FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=U FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:
PORTLAND CEMENT IS AN ODORLESS, GRAY SOLID.
CAUSES SKIN AND EYE IRRITATION. NO KNOWN FIRE OR REACTIVITY HAZARD.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING. WASH THOROUGHLY AFTER HANDLING.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.
LONG TERM EFFECTS: MAY CAUSE COUGHING, DIFFICULTY BREATHING AND LUNG DAMAGE.
SKIN CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE SORES AND BURNS.
LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, RASH MAY OCCUR.
EYE CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE VISUAL DISTURBANCES.

LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.

INGESTION:

SHORT TERM EXPOSURE: NO INFORMATION IS AVAILABLE.

LONG TERM EFFECTS: NO INFORMATION AVAILABLE ON SIGNIFICANT ADVERSE EFFECTS.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION:

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION.

NOTE TO PHYSICIAN

ANTIDOTE

NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:

NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

EXTINGUISHING MEDIA:

DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM

FIREFIGHTING:

NO ACUTE HAZARD. MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. AVOID BREATHING VAPORS OR DUSTS; KEEP UPWIND.

HAZARDOUS COMBUSTION PRODUCTS:
NOT APPLICABLE.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
FOR LARGE SPILLS, SWEEP UP WITH A MINIMUM OF DUSTING AND PLACE INTO SUITABLE CLEAN, DRY CONTAINERS FOR RECLAMATION OR LATER DISPOSAL.

RESIDUE SHOULD BE CLEANED UP USING A HIGH-EFFICIENCY PARTICULATE FILTER VACUUM.

SECTION 7 HANDLING AND STORAGE

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING THIS SUBSTANCE.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
PORTLAND CEMENT:
5 MG/M3 OSHA TWA (RESPIRABLE FRACTION); 10 MG/M3 OSHA TWA (TOTAL DUST)
10 MG/M3 ACGIH TWA (TOTAL DUST) (NO ASBESTOS AND <1% FREE SILICA)
5 MG/M3 NIOSH RECOMMENDED TWA (RESPIRABLE FRACTION);
10 MG/M3 NIOSH RECOMMENDED TWA (TOTAL DUST)

MEASUREMENT METHOD: PARTICULATE FILTER; GRAVIMETRIC; (NIOSH VOL. III # 0500, NUISANCE DUST (TOTAL)).

OSHA REVOKED THE FINAL RULE LIMITS OF JANUARY 19, 1989 IN RESPONSE TO THE 11TH CIRCUIT COURT OF APPEALS DECISION (AFL-CIO V. OSHA) EFFECTIVE JUNE 30, 1993. SEE 29 CFR 1910.1000 (58 FR 35338)

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

PORTLAND CEMENT:
50 MG/M3- DUST RESPIRATOR.

100 MG/M3- ANY DUST RESPIRATOR EXCEPT SINGE-USE AND QUARTER-MASK RESPIRATORS.
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

250 MG/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH A DUST FILTER.
ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

500 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SUPPLIED-AIR RESPIRATOR WITH A TIGHT-FITTING FACEPIECE OPERATED IN A CONTINUOUS FLOW MODE.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND A HIGH-EFFICIENCY PARTICULATE FILTER.

5000 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE: ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

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.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: ODORLESS, FINELY DIVIDED GRAY POWDER.
SPECIFIC GRAVITY: NOT AVAILABLE
WATER SOLUBILITY: INSOLUBLE

PH: 12 (WET CEMENT)

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

CONDITIONS TO AVOID:
NONE REPORTED.

INCOMPATIBILITIES:
PORTLAND CEMENT:
NO DATA AVAILABLE.

HAZARDOUS DECOMPOSITION:
NOT APPLICABLE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

PORTLAND CEMENT:
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: IRRITANT- SKIN, EYE.
ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.
TARGET EFFECTS: NO DATA AVAILABLE.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH IMPAIRED RESPIRATORY FUNCTION.

HEALTH EFFECTS
INHALATION:
PORTLAND CEMENT:
ACUTE EXPOSURE- MAY CAUSE IRRITATION TO THE MUCOUS MEMBRANES. EXCESSIVE EXPOSURES MAY RESULT IN CAKING IN THE NOSE.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO PORTLAND CEMENT MAY CAUSE COUGH ACCOMPANIED BY PHLEGM. EPIDEMIOLOGICAL STUDIES INDICATE THAT HEAVY OR PROLONGED EXPOSURE TO FINISHED PORTLAND CEMENT DOES NOT CAUSE PNEUMOCONIOSIS. LONG TERM EXPOSURE TO RAW OR MIXED CEMENT DUSTS MAY CAUSE COUGH, EXPECTORATION, DYSPNEA, WHEEZING, PHARYNGITIS, CHRONIC BRONCHITIS, EMPHYSEMA, CEMENT PNEUMOCONIOSIS, AND SILICOSIS.

SKIN CONTACT:
PORTLAND CEMENT:
IRRITANT.
ACUTE EXPOSURE- DRY PORTLAND CEMENT MAY CAUSE IRRITATION AND DERMATITIS. DIRECT CONTACT WITH WET CEMENT, COMBINED WITH PROLONGED CONTACT TIME, AND PRESSURE ON AREAS BY KNEELING OR BY OCCLUSION MAY CAUSE ULCERATIONS AND POSSIBLY BURNS. SENSITIVITY TO CONSTITUENTS OF CEMENT MAY INDUCE ALLERGIC SKIN REACTIONS.
CHRONIC EXPOSURE- CHRONICALLY EXPOSED WORKERS MAY EXHIBIT CEMENT DERMATITIS WHICH ASSUMES MANY FORMS: SKIN DRYNESS, FISSURES, DYSTROPHY OF NAILS, AND

ECZEMATOUS RASHES.

EYE CONTACT:
PORTLAND CEMENT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION. WET CEMENT MAY CAUSE A BURNING SENSATION, CORNEAL EDEMA INDICATED BY SEEING HALOS AROUND LIGHTS, AND INJURY TO THE CONJUNCTIVA.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS AND BLEPHARITIS.

INGESTION:
PORTLAND CEMENT:
ACUTE EXPOSURE- NO DATA AVAILABLE.
CHRONIC EXPOSURE- A HIGH INCIDENCE OF GASTRODUODENAL ULCERS HAVE BEEN REPORTED IN CEMENT WORKERS. GASTRIC ULCERS HAVE BEEN INDUCED IN ANIMALS FED CEMENT DUST.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

SECTION 14 TRANSPORTATION INFORMATION

NO CLASSIFICATION CURRENTLY ASSIGNED

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4): N
SARA SECTION 302 (40CFR355.30): N
SARA SECTION 304 (40CFR355.40): N
SARA SECTION 313 (40CFR372.65): N
OSHA PROCESS SAFETY (29CFR1910.119): N
CALIFORNIA PROPOSITION 65: N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16 OTHER

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p-XYLENE

XLP

Common Synonyms	Watery liquid	Colorless	Sweet odor
1, 4-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced. Freezing point is 56°F.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** $p\text{-}C_6H_4(CH_3)_2$
3.3 **IMO/UN Designation:** 3.2/1307
3.4 **DOT ID No.:** 1307
3.5 **CAS Registry No.:** 106-42-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Like benzene; characteristic aromatic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 **Symptoms Following Exposure:** Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 300 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Kidney and liver damage.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.05 ppm
5.11 **IDLH Value:** 10,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 81°F C.C.
6.2 **Flammable Limits in Air:** 1.1%-6.6%
6.3 **Fire Extinguishing Agents:** Foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 870°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.8 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0 lb/lb in 5 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research: 99.99%; Pure: 99.6%; Technical: 99.0%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 106.16
12.3 **Boiling Point at 1 atm:** 280.9°F = 138.3°C = 411.5°K
12.4 **Freezing Point:** 55.9°F = 13.3°C = 286.5°K
12.5 **Critical Temperature:** 649.4°F = 343.0°C = 616.2°K
12.6 **Critical Pressure:** 509.4 atm = 34.65 psia = 3.510 MN/m^2
12.7 **Specific Gravity:** 0.861 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 28.3 dynes/cm = 0.0283 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 37.8 dynes/cm = 0.0378 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.071
12.12 **Latent Heat of Vaporization:** 150 Btu/lb = 81 cal/g = 3.4×10^5 J/kg
12.13 **Heat of Combustion:** −17,559 Btu/lb = −9754.7 cal/g = -408.41×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 37.83 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.34 psia

NOTES

p-XYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	53.970
65	53.830
70	53.690
75	53.550
80	53.410
85	53.270
90	53.140
95	53.000
100	52.860
105	52.720
110	52.580
115	52.440
120	52.300

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
60	.412
70	.418
80	.424
90	.429
100	.435
110	.440
120	.446
130	.451
140	.457
150	.462
160	.468
170	.474
180	.479
190	.485
200	.490
210	.496
220	.501
230	.507
240	.512
250	.518
260	.524
270	.529
280	.535

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
60	.935
65	.928
70	.921
75	.914
80	.907
85	.900
90	.892
95	.885
100	.878

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
60	.678
65	.654
70	.631
75	.610
80	.590
85	.571
90	.552
95	.535
100	.519
105	.503
110	.488
115	.474
120	.460

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
60	.096
70	.135
80	.187
90	.255
100	.343
110	.456
120	.599
130	.777
140	.998
150	1.270
160	1.600
170	1.998
180	2.475
190	3.041
200	3.710
210	4.493
220	5.407
230	6.465
240	7.683
250	9.080
260	10.670

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	.00183
70	.00252
80	.00343
90	.00459
100	.00607
110	.00792
120	.01022
130	.01303
140	.01646
150	.02059
160	.02553
170	.03138
180	.03826
190	.04629
200	.05561
210	.06636
220	.07867
230	.09270
240	.10860
250	.12650
260	.14670

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.246
25	.259
50	.272
75	.285
100	.297
125	.309
150	.321
175	.333
200	.345
225	.357
250	.368
275	.380
300	.391
325	.402
350	.413
375	.424
400	.435
425	.445
450	.456
475	.466
500	.476
525	.486
550	.496
575	.505
600	.515

SODIUM HYDROXIDE

SHD

Common Synonyms	Solid flakes or pellets White Odorless
Caustic soda Lye	Sinks and mixes with water.

Avoid contact with solid and dust. Keep people away.
Wear rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
May cause fire on contact with combustibles.
Flammable gas may be produced on contact with metals.

Wear rubber overclothing (including gloves).
Flood discharge area with water.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

DUST
Irritating to eyes, nose and throat.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.
IF IN EYES, hold eyelids open and flush with plenty of water.

SOLID
Will burn skin and eyes.
Harmful if swallowed.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-corrosive
Restrict access
Disperse and flush

2. LABEL

2.1 Category: Corrosive
2.2 Class: 8

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Caustics
3.2 Formula: NaOH
3.3 IMO/UN Designation: 8.0/1823
3.4 DOT ID No.: 1823
3.5 CAS Registry No.: 1310-73-2

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: White
4.3 Odor: Odorless

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Chemical safety goggles; face shield; filter or dust-type respirator; rubber boots; rubber gloves.
5.2 Symptoms Following Exposure: Strong corrosive action on contacted tissues. INHALATION: dust may cause damage to upper respiratory tract and lung itself, producing from mild nose irritation to pneumonitis. INGESTION: severe damage to mucous membranes; severe scar formation or perforation may occur. EYE CONTACT: produces severe damage.
5.3 Treatment of Exposure: INHALATION: remove from exposure; support respiration; call physician. INGESTION: give water or milk followed by dilute vinegar or fruit juice; do NOT induce vomiting. SKIN: wash immediately with large quantities of water under emergency safety shower while removing clothing; continue washing until medical help arrives; call physician. EYES: irrigate immediately with copious amounts of water for at least 15 min.; call physician.
5.4 Threshold Limit Value: 2 mg/m³
5.5 Short Term Inhalation Limits: Not pertinent
5.6 Toxicity by Ingestion: (10% solution) oral rabbit LD_{Lo} = 500 mg/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Non-volatile
5.9 Liquid or Solid Irritant Characteristics: Severe skin irritant. Causes second-and third-degree burns on short contact and is very injurious to the eyes.
5.10 Odor Threshold: Not pertinent
5.11 IDLH Value: 200 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Dissolves with liberation of much heat; may steam and splatter
7.2 Reactivity with Common Materials: When wet, attacks metals such as aluminum, tin, lead, and zinc to produce flammable hydrogen gas.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Flush with water, rinse with dilute acetic acid
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 5

8. WATER POLLUTION

8.1 Aquatic Toxicity:
125 ppm/96 hr/mosquito fish/TL_m/fresh
180 ppm/23 hr/oysters/lethal/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical flakes; USP pellets
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

SS

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Corrosive material
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 40.00
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: 604°F = 318°C = 591°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 2.13 at 20°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 50.0 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

SODIUM HYDROXIDE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	44.810		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT
36	47.660						
38	50.500						
40	53.350						
42	56.190						
44	59.040						
46	61.880						
48	64.719						
50	67.570						
52	70.410						
54	73.259						
56	76.099						
58	78.950						
60	81.790						
62	84.639						
64	87.480						
66	90.320						
68	93.169						
70	96.009						
72	98.860						
74	101.700						
76	104.500						
78	107.400						
80	110.200						
82	113.099						
84	115.900						

TRICHLOROFLUOROMETHANE

TCF

Common Synonyms	Liquid	Colorless	Odorless
F-11; Freon 11 Genetron 11 Arcton 9 Isceon 11; Eskimon 11 Frigen 11 Isotron 11; Ucon 11	Sinks in water. Harmful vapor is produced. Boiling point is 75°F.		

Stop discharge if possible. Keep people away.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

VAPOR
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Not harmful.

Water Pollution

Not harmful to aquatic life.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $CFCl_3$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: Data not available
3.5 CAS Registry No.: 75-69-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Odorless; weak chlorinated solvent

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Air line respirator; rubber gloves; monogoggles
5.2 Symptoms Following Exposure: Breathing concentrations approaching 10% in air will cause dizziness and drowsiness. Contact with tissues may cause frostbite.
5.3 Treatment of Exposure: INHALATION: remove victim to non-contaminated area and apply artificial respiration if breathing has stopped; call a physician immediately; oxygen inhalation may be utilized. SKIN: if frostbite has occurred, flush areas with warm water.
5.4 Threshold Limit Value: 1000 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Data not available
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Non-irritating
5.9 Liquid or Solid Irritant Characteristics: May cause frostbite.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Produces irritating and toxic products when heated to decomposition temperatures.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: None
8.2 Waterfowl Toxicity: None
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Safety relief

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-C-I-J

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Not listed
11.2 NAS Hazard Rating for Bulk Water Transportation: Data not available
11.3 NFPA Hazard Classification: Data not available

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Data not available
12.2 Molecular Weight: Data not available
12.3 Boiling Point at 1 atm: Data not available
12.4 Freezing Point: Data not available
12.5 Critical Temperature: Data not available
12.6 Critical Pressure: Data not available
12.7 Specific Gravity: Data not available
12.8 Liquid Surface Tension: Data not available
12.9 Liquid Water Interfacial Tension: Data not available
12.10 Vapor (Gas) Specific Gravity: Data not available
12.11 Ratio of Specific Heats of Vapor (Gas): Data not available
12.12 Latent Heat of Vaporization: Data not available
12.13 Heat of Combustion: Data not available
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

TCF TRICHLOROFLUOROMETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—35	100.200
—30	99.809
—25	99.459
—20	99.110
—15	98.770
—10	98.419
—5	98.070
0	97.730
5	97.379
10	97.030
15	96.690
20	96.339
25	95.990
30	95.650
35	95.299
40	94.950
45	94.610
50	94.259
55	93.910
60	93.570
65	93.219
70	92.870
75	92.520
80	92.179
85	91.830
90	91.480

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
—140	.189
—120	.191
—100	.193
—80	.196
—60	.198
—40	.200
—20	.202
0	.204
20	.207
40	.209
60	.211
80	.213
100	.216
120	.218
140	.220
160	.222

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	NOT PERTINENT

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.110

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—50	.560
—40	.780
—30	1.072
—20	1.451
—10	1.937
0	2.554
10	3.329
20	4.291
30	5.473
40	6.914
50	8.655
60	10.740
70	13.220
80	16.150
90	19.580
100	23.580
110	28.210
120	33.550

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—50	.01749
—40	.02381
—30	.03193
—20	.04223
—10	.05514
0	.07113
10	.09072
20	.11450
30	.14310
40	.17710
50	.21740
60	.26450
70	.31950
80	.38300
90	.45600
100	.53930
110	.63390
120	.74080

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
30	.127
35	.127
40	.127
45	.127
50	.127
55	.127
60	.127
65	.127
70	.127
75	.127
80	.127
85	.127
90	.127
95	.127
100	.127
105	.127
110	.127
115	.127
120	.127
125	.127
130	.127
135	.127
140	.127
145	.127
150	.127
155	.127

TOLUENE

TOL

Common Synonyms	Watery liquid	Colorless	Pleasant odor
Toluol Methylbenzene Methylbenzol	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** $C_6H_5CH_3$
3.3 **IMO/UN Designation:** 3.2/1294
3.4 **DOT ID No.:** 1294
3.5 **CAS Registry No.:** 108-88-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Pungent; aromatic, benzene-like; distinct, pleasant

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Air-supplied mask; goggles or face shield; plastic gloves.
5.2 **Symptoms Following Exposure:** Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 600 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** Kidney and liver damage may follow ingestion.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.17 ppm
5.11 **IDLH Value:** 2,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 40°F C.C.; 55°F O.C.
6.2 **Flammable Limits in Air:** 1.27%-7%
6.3 **Fire Extinguishing Agents:** Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 997°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.7 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 1180 mg/l/96 hr/sunfish/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0%, 5 days; 38% (theor), 8 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research, reagent, nitration-all 99.8 + %; industrial: contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial.
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 92.14
12.3 **Boiling Point at 1 atm:** 231.1°F = 110.6°C = 383.8°K
12.4 **Freezing Point:** −139°F = −95.0°C = 178.2°K
12.5 **Critical Temperature:** 605.4°F = 318.6°C = 591.8°K
12.6 **Critical Pressure:** 596.1 psia = 40.55 atm = 4.108 MN/m^2
12.7 **Specific Gravity:** 0.867 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 29.0 dynes/cm = 0.0290 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 36.1 dynes/cm = 0.0361 N/m at 25°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.089
12.12 **Latent Heat of Vaporization:** 155 Btu/lb = 86.1 cal/g = 3.61 X 10^5 J/kg
12.13 **Heat of Combustion:** −17,430 Btu/lb = −9686 cal/g = −405.5 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 17.17 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 1.1 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

TOLUENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—30	57.180
—20	56.870
—10	56.550
0	56.240
10	55.930
20	55.620
30	55.310
40	54.990
50	54.680
60	54.370
70	54.060
80	53.750
90	53.430
100	53.120
110	52.810
120	52.500

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.396
5	.397
10	.399
15	.400
20	.402
25	.403
30	.404
35	.406
40	.407
45	.409
50	.410
55	.411
60	.413
65	.414
70	.415
75	.417
80	.418
85	.420
90	.421
95	.422
100	.424
105	.425
110	.427
115	.428
120	.429
125	.431

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
0	1.026
10	1.015
20	1.005
30	.994
40	.983
50	.972
60	.962
70	.951
80	.940
90	.929
100	.919
110	.908
120	.897
130	.886
140	.876
150	.865
160	.854
170	.843
180	.833
190	.822
200	.811
210	.800

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
0	1.024
5	.978
10	.935
15	.894
20	.857
25	.821
30	.788
35	.757
40	.727
45	.700
50	.673
55	.649
60	.625
65	.603
70	.582
75	.562
80	.544
85	.526
90	.509
95	.493
100	.477

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.050

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
0	.038
10	.057
20	.084
30	.121
40	.172
50	.241
60	.331
70	.449
80	.600
90	.792
100	1.033
110	1.332
120	1.700
130	2.148
140	2.690
150	3.338
160	4.109
170	5.018
180	6.083
190	7.323
200	8.758
210	10.410

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
0	.00070
10	.00103
20	.00150
30	.00212
40	.00296
50	.00405
60	.00547
70	.00727
80	.00954
90	.01237
100	.01584
110	.02007
120	.02518
130	.03127
140	.03850
150	.04700
160	.05691
170	.06840
180	.08162
190	.09675
200	.11400
210	.13340

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.228
25	.241
50	.255
75	.268
100	.281
125	.294
150	.306
175	.319
200	[illegible]
225	[illegible]
250	.355
275	.367
300	.378
325	.389
350	.400
375	.411
400	.422
425	.432
450	.443
475	.453
500	.462
525	[illegible]
550	[illegible]
575	.491
600	.500

STYRENE

STY

Common Synonyms	Watery liquid	Colorless to light yellow	Sweet pleasant odor
Styrol Vinylbenzene Phenylethylene Styrolene	Floats on water. Flammable, irritating vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Wear chemical protective suit with self-contained breathing apparatus.
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
CONTAINERS MAY EXPLODE IN FIRE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Wear chemical protective suit with self-contained breathing apparatus.
Combat fires from safe distance or protected location.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or loss of consciousness.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-air contaminant
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Olefin
3.2 **Formula:** $C_6H_5CH{=}CH_2$
3.3 **IMO/UN Designation:** 3.3/2055
3.4 **DOT ID No.:** 2055
3.5 **CAS Registry No.:** 100-42-5

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Sweet at low concentrations; characteristic pungent; sharp; disagreeable

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Air-supplied mask or approved canister; rubber or plastic gloves; boots; goggles or face shield.
5.2 **Symptoms Following Exposure:** Moderate irritation of eyes and skin. High vapor concentrations cause dizziness, drunkeness, and anesthesia.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air; keep warm and quiet; use artificial respiration if needed. INGESTION: do NOT induce vomiting; call physician; no known antidote. SKIN OR EYE CONTACT: flush with plenty of water; for eyes get medical attention.
5.4 **Threshold Limit Value:** 50 ppm
5.5 **Short Term Inhalation Limits:** 100 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 **Odor Threshold:** 0.148 ppm
5.11 **IDLH Value:** 5,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 93°F O.C.; 88°F C.C.
6.2 **Flammable Limits in Air:** 1.1%-6.1%
6.3 **Fire Extinguishing Agents:** Water fog, foam, carbon dioxide, or dry chemical
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. At elevated temperatures such as in fire conditions, polymerization may take place which may lead to container explosion.
6.7 **Ignition Temperature:** 914°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.2 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** May occur if heated above 150°F. Can cause rupture of container. Metal salts, peroxides, and strong acids may also cause polymerization.
7.6 **Inhibitor of Polymerization:** Tertiary-butylcatechol, 10-15 ppm
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 30

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 18% (theor.), 412 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 99.5+%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-Z

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	3

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 104.15
12.3 **Boiling Point at 1 atm:** 293.4°F = 145.2°C = 418.4°K
12.4 **Freezing Point:** −23.1°F = −30.6°C = 242.6°K
12.5 **Critical Temperature:** 703°F = 373°C = 646°K
12.6 **Critical Pressure:** 580 psia = 39.46 atm = 4.00 MN/m^2
12.7 **Specific Gravity:** 0.906 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 32.14 dynes/cm = 0.03214 N/m at 19°C
12.9 **Liquid Water Interfacial Tension:** 35.48 dynes/cm = 0.03548 N/m at 19°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.074
12.12 **Latent Heat of Vaporization:** 156 Btu/lb = 86.8 cal/g = 3.63×10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** −277 Btu/lb = −154 cal/g = -6.45×10^5 J/kg
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.27 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

STYRENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	57.430
50	57.120
60	56.800
70	56.490
80	56.180
90	55.870
100	55.560
110	55.240
120	54.930
130	54.620
140	54.310
150	54.000
160	53.680
170	53.370
180	53.060
190	52.750
200	52.430
210	52.120

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.389
5	.391
10	.393
15	.395
20	.397
25	.399
30	.401
35	.403
40	.405
45	.407
50	.409
55	.411
60	.413
65	.415
70	.417
75	.419
80	.421
85	.423
90	.424
95	.426
100	.428
105	.430
110	.432
115	.434
120	.436

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
15	1.087
20	1.080
25	1.074
30	1.067
35	1.060
40	1.054
45	1.047
50	1.040
55	1.033
60	1.027
65	1.020
70	1.013
75	1.006
80	1.000
85	.993
90	.986
95	.980
100	.973
105	.966
110	.959
115	.953
120	.946

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
40	.950
50	.872
60	.803
70	.742
80	.688
90	.639
100	.595
110	.556
120	.521
130	.488
140	.459
150	.433
160	.408
170	.386
180	.366
190	.347
200	.330
210	.314

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.300

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
40	.034
50	.049
60	.070
70	.099
80	.137
90	.188
100	.254
110	.339
120	.447
130	.583
140	.753
150	.963
160	1.221
170	1.534
180	1.912
190	2.365
200	2.905
210	3.542
220	4.292
230	5.167
240	6.183
250	7.358
260	8.709
270	10.250
280	12.010
290	14.010

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	.00066
50	.00094
60	.00131
70	.00181
80	.00247
90	.00332
100	.00440
110	.00577
120	.00748
130	.00959
140	.01218
150	.01532
160	.01911
170	.02364
180	.02900
190	.03533
200	.04272
210	.05132
220	.06126
230	.07269
240	.08575
250	.10060
260	.11740
270	.13630
280	.15760
290	.18130

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.239
25	.253
50	.266
75	.279
100	.292
125	.304
150	.317
175	.329
200	.340
225	.352
250	.363
275	.374
300	.385
325	.396
350	.406
375	.416
400	.426
425	.435
450	.445
475	.454
500	.462
525	.471
550	.479
575	.487
600	.495

HYDROCHLORIC ACID

HCL

Common Synonyms	Watery liquid	Colorless	Sharp, irritating odor
Muriatic Acid	Sinks and mixes with water. Irritating vapor is produced.		

AVOID CONTACT WITH LIQUID AND VAPOR. Keep people away.
Wear chemical protective suit with self-contained breathing apparatus.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
Flammable gas may be produced on contact with metals.
Wear chemical protective suit with self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause coughing or difficult breathing.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-corrosive
Restrict access
Disperse and flush

2. LABEL

2.1 Category: Corrosive
2.2 Class: 8

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Non-oxidizing mineral acid
3.2 Formula: HCl-H_2O
3.3 IMO/UN Designation: 8.0/1789
3.4 DOT ID No.: 1789
3.5 CAS Registry No.: 7647-01-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to light yellow
4.3 Odor: Pungent; sharp, pungent, irritating

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Self-contained breathing equipment, air-line mask, or industrial canister-type gas mask; rubber or rubber-coated gloves, apron, coat, overalls, shoes.
5.2 Symptoms Following Exposure: Inhalation of fumes results in coughing and choking sensation, and irritation of nose and lungs. Liquid causes burns.
5.3 Treatment of Exposure: INHALATION: remove person to fresh air; keep him warm and quiet and get medical attention immediately; start artificial respiration if breathing stops. INGESTION: have person drink water or milk; do NOT induce vomiting. EYES: immediately flush with plenty of water for at least 15 min. and get medical attention; continue flushing for another 15 min. if physician does not arrive promptly. SKIN: immediately flush skin while removing contaminated clothing; get medical attention promptly; use soap and wash area for at least 15 min.
5.4 Threshold Limit Value: 5 ppm
5.5 Short Term Inhalation Limits: 5 ppm for 5 min.
5.6 Toxicity by Ingestion: Data not available
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations.
5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant; may cause pain and second-degree burns after a few minutes' contact.
5.10 Odor Threshold: 1-5 ppm
5.11 IDLH Value: 100 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic and irritating vapors are generated when heated.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: Corrosive to most metals with evolution of hydrogen gas, which may form explosive mixtures with air.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Flush with water; apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate.
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 1

8. WATER POLLUTION

8.1 Aquatic Toxicity: 282 ppm/96 hr/mosquito fish/TL_m/fresh water
100-330 ppm/48 hr/shrimp/LC_{50}/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Food processing or technical: 18° Be-27.9%, 20 Be-31.5%, 22° Be-35.2%; Reagent, ACS, and USP: 23° Be-37.1%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Corrosive material
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	0
Health	
Vapor Irritant	3
Liquid or Solid Irritant	3
Poisons	2
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	3
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 36.46
12.3 Boiling Point at 1 atm: 123°F = 50.5°C = 323.8°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.19 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: 178 Btu/lb = 98.6 cal/g = 4.13 X 10^5 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: —860 Btu/lb = —480 cal/g = —20 X 10^5 J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 13.0 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 8.0 psia

*Physical properties apply to 37 % solution.

NOTES

HCL HYDROCHLORIC ACID

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
40	74.770	35	.417		N		N
50	74.599	40	.429		O		O
60	74.419	45	.441		T		T
70	74.250	50	.453				
80	74.080	55	.465		P		P
90	73.900	60	.477		E		E
100	73.730	65	.489		R		R
110	73.559	70	.501		T		T
120	73.381	75	.513		I		I
		80	.525		N		N
		85	.537		E		E
		90	.548		N		N
		95	.560		T		T
		100	.572				
		105	.584				
		110	.596				
		115	.608				
		120	.620				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	M	52	1.844		N		N
	I	54	1.970		O		O
	S	56	2.104		T		T
	C	58	2.246				
	I	60	2.396		P		P
	B	62	2.555		E		E
	L	64	2.723		R		R
	E	66	2.901		T		T
		68	3.088		I		I
		70	3.287		N		N
		72	3.496		E		E
		74	3.717		N		N
		76	3.951		T		T
		78	4.197				
		80	4.456				
		82	4.730				
		84	5.018				
		86	5.321				
		88	5.640				
		90	5.975				
		92	6.328				
		94	6.699				
		96	7.089				
		98	7.499				
		100	7.929				
		102	8.380				

n-HEXANE

HXA

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Hexane	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to nose and throat.
If inhaled, will cause coughing or dizziness.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea or vomiting.

Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Disperse and flush

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Paraffin
3.2 Formula: $CH_3(CH_2)_4CH_3$
3.3 IMO/UN Designation: 3.1/1208
3.4 DOT ID No.: 1208
3.5 CAS Registry No.: 110-54-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like gasoline

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Eye protection (like gasoline).
5.2 Symptoms Following Exposure: INHALATION causes irritation of respiratory tract, cough, mild depression, cardiac arrhythmias. ASPIRATION causes severe lung irritation, coughing, pulmonary edema; excitement followed by depression. INGESTION causes nausea, vomiting, swelling of abdomen, headache, depression.
5.3 Treatment of Exposure: Call a doctor. INHALATION: maintain respiration; give oxygen if needed. ASPIRATION: enforce bed rest; give oxygen if needed. INGESTION: do NOT induce vomiting. SKIN OR EYES: wipe off; wash skin with soap and water; wash eyes with copious amounts of water.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Very slight
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to the eyes and throat.
5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 5,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: —7°F C.C.
6.2 Flammable Limits in Air: 1.2%-7.7%
6.3 Fire Extinguishing Agents: Foam, dry chemical, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapors may explode
6.7 Ignition Temperature: 437°F
6.8 Electrical Hazard: Class I, group D
6.9 Burning Rate: 7.3 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 31

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0% (theor.), 7 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research grade; technical grade
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	0
Liquid or Solid Irritant	0
Poisons	1
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	1
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 86.17
12.3 Boiling Point at 1 atm: 155.7°F = 68.7°C = 341.9°K
12.4 Freezing Point: -219.3°F = -139.6°C = 133.6°K
12.5 Critical Temperature: 453.6°F = 234.2°C = 507.4°K
12.6 Critical Pressure: 436.6 psia = 29.7 atm = 3.01 MN/m²
12.7 Specific Gravity: 0.659 at 20°C (liquid)
12.8 Liquid Surface Tension: 18.4 dynes/cm = 0.0184 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 51.1 dynes/cm = 0.0511 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 3.0
12.11 Ratio of Specific Heats of Vapor (Gas): 1.063
12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.0 cal/g = 3.35 X 10^5 J/kg
12.13 Heat of Combustion: —19,246 Btu/lb = —10,692 cal/g = —447.65 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 36.27 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 5.0 psia

NOTES

HXA	n-HEXANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	42.220
40	42.060
45	41.890
50	41.730
55	41.570
60	41.400
65	41.240
70	41.070
75	40.910
80	40.740
85	40.580
90	40.410
95	40.250
100	40.080
105	39.920
110	39.750
115	39.590
120	39.420
125	39.260
130	39.090
135	38.930
140	38.760
145	38.600

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.502
10	.508
20	.513
30	.519
40	.524
50	.530
60	.535
70	.541
80	.547
90	.552
100	.558
110	.563
120	.569
130	.574
140	.580
150	.585

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—5	.933
0	.927
5	.921
10	.914
15	.908
20	.902
25	.895
30	.889
35	.883
40	.876
45	.870
50	.863
55	.857
60	.851
65	.844
70	.838
75	.832
80	.825
85	.819
90	.813
95	.806
100	.800
105	.794
110	.787
115	.781

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
35	.334
40	.330
45	.327
50	.324
55	.321
60	.318
65	.315
70	.312
75	.309
80	.306
85	.304
90	.301
95	.298
100	.296
105	.294
110	.291
115	.289
120	.287
125	.285
130	.282
135	.280
140	.278
145	.276

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	I
	N
	S
	O
	L
	U
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
0	.312
10	.439
20	.607
30	.827
40	1.108
50	1.466
60	1.913
70	2.467
80	3.147
90	3.971
100	4.962
110	6.143
120	7.539
130	9.177
140	11.090
150	13.300
160	15.840
170	18.740
180	22.050
190	25.780
200	29.990
210	34.700

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
0	.00545
10	.00750
20	.01016
30	.01355
40	.01781
50	.02308
60	.02955
70	.03740
80	.04681
90	.05799
100	.07116
110	.08656
120	.10440
130	.12490
140	.14840
150	.17510
160	.20520
170	.23890
180	.27670
190	.31860
200	.36490
210	.41600

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.350
25	.365
50	.381
75	.396
100	.411
125	.426
150	.440
175	.455
200	.469
225	.484
250	.498
275	.512
300	.526
325	.539
350	.553
375	.566
400	.579
425	.592
450	.605
475	.618
500	.630
525	.642
550	.655
575	.667
600	.678

SULFURIC ACID

SFA

Common Synonyms	Oily liquid	Colorless	Odorless
Oil of vitriol Battery acid Fertilizer acid Chamber acid	Sinks and mixes violently with water. Irritating mist is produced.		

AVOID CONTACT WITH LIQUID. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
May cause fire on contact with combustibles.
Flammable gas may be produced on contact with metals.
POISONOUS GAS MAY BE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing.
DO NOT USE WATER ON ADJACENT FIRES.
Extinguish with dry chemical or carbon dioxide.

Exposure

CALL FOR MEDICAL AID.

MIST
Irritating to eyes, nose and throat.
If inhaled, will cause coughing, difficult breathing, or loss of consciousness.
Move to fresh air.
IF IN EYES, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.
LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-corrosive
Restrict access
Disperse and flush with care

2. LABEL

2.1 **Category:** Corrosive
2.2 **Class:** 8

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Sulfuric acid
3.2 **Formula:** H_2SO_4
3.3 **IMO/UN Designation:** 8.0/1830
3.4 **DOT ID No.:** 1830
3.5 **CAS Registry No.:** 7664-93-9

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless (pure) to dark brown
4.3 **Odor:** Odorless unless hot, then choking

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Safety shower; eyewash fountain; safety goggles; face shield; approved respirator (self-contained or air-line); rubber safety shoes; rubber apron.
5.2 **Symptoms Following Exposure:** Inhalation of vapor from hot, concentrated acid may injure lungs. Swallowing may cause severe injury or death. Contact with skin or eyes causes severe burns.
5.3 **Treatment of Exposure:** Call a doctor. INHALATION: Observe victim for delayed pulmonary reaction. INGESTION: Have victim drink water if possible; do NOT induce vomiting. EYES AND SKIN: Wash with large amounts of water for at least 15 min.; do not use oils or ointments in eyes; treat skin burns.
5.4 **Threshold Limit Value:** 1 mg/m³
5.5 **Short Term Inhalation Limits:** 10 mg/m³ for 5 min.; 5 mg/m³ for 10 min.; 2 mg/m³ for 30 min.; 1 mg/m³ for 60 min.
5.6 **Toxicity by Ingestion:** No effects except those secondary to tissue damage.
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors from hot acid (77-98%) cause moderate irritation of eyes and respiratory system. Effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** 77-98% acid causes severe second- and third-degree burns of skin on short contact and is very injurious to the eyes.
5.10 **Odor Threshold:** Greater than 1 mg/m³
5.11 **IDLH Value:** 80 mg/m³

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Water used on adjacent fires should be carefully handled.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Not flammable
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** None
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Reacts violently with evolution of heat. Spattering occurs when water is added to the compound.
7.2 **Reactivity with Common Materials:** Extremely hazardous in contact with many materials, particularly metals and combustibles. Dilute acid reacts with most metals, releasing hydrogen which can form explosive mixtures with air in confined spaces.
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Dilute with water, then neutralize with lime, limestone, or soda ash.
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent

(Continued)

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 24.5 ppm/24 hr/bluegill/lethal/fresh water
42.5 ppm/48 hr/prawn/LC_{50}/salt water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** CP; USP; Technical, at 33% to 98% (50° Be to 66° Be).
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-O

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Corrosive material
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	0
Health	
Vapor Irritant	2
Liquid or Solid Irritant	4
Poisons	2
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	4
Water	3
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 98.08
12.3 **Boiling Point at 1 atm:** 644°F = 340°C = 613°K
12.4 **Freezing Point:** Not pertinent
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.84 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** Not pertinent
12.12 **Latent Heat of Vaporization:** Not pertinent
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** —418.0 Btu/lb = —232.2 cal/g = —9.715 X 10^5 J/kg
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Low

*Physical properties apply to concentrated (98%) acid unless otherwise stated. More dilute acid is more water-like.

7. CHEMICAL REACTIVITY (Continued)

7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 2

SULFURIC ACID

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	115.400
40	115.200
45	115.000
50	114.900
55	114.700
60	114.500
65	114.299
70	114.200
75	114.000
80	113.799
85	113.599
90	113.500
95	113.299
100	113.099
105	112.900
110	112.799
115	112.599
120	112.400

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.330
40	.331
45	.331
50	.332
55	.333
60	.333
65	.334
70	.334
75	.335
80	.335
85	.336
90	.336
95	.337
100	.338
105	.338
110	.339
115	.339
120	.340

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	NOT PERTINENT

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	MISCIBLE

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
	NOT PERTINENT

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
	NOT PERTINENT

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
	NOT PERTINENT

METHYL ALCOHOL

MAL

Common Synonyms	Watery liquid	Colorless	Alcohol odor
Methanol Wood alcohol Wood spirit Pyroxylic spirit Colonial spirit Columbian spirit	Floats and mixes with water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Vapor may explode if ignited in an enclosed area.
Flashback along vapor trail may occur.
Extinguish with dry chemical, alcohol foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access
Evacuate area
Disperse and flush

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Alcohol, glycol
3.2 **Formula:** CH_3OH
3.3 **IMO/UN Designation:** 3.2/1230
3.4 **DOT ID No.:** 1230
3.5 **CAS Registry No.:** 67-56-1

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Faint alcohol; like ethyl alcohol; faintly sweet; charactenstic pungent

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved canister mask for high vapor concentrations; safety goggles; rubber gloves.
5.2 **Symptoms Following Exposure:** Exposure to excessive vapor causes eye irritation, head- ache, fatigue and drowsiness. High concentrations can produce central nervous system depression and optic nerve damage. 50,000 ppm will probably cause death in 1 to 2 hrs. Can be absorbed through skin. Swallowing may cause death or eye damage.
5.3 **Treatment of Exposure:** Remove victim from exposure and apply artifical respiration if breathing has ceased. INGESTION: induce vomiting, then give 2 teaspoons of baking soda in glass of water; call a physician. SKIN OR EYES: flush with water for 15 min.
5.4 **Threshold Limit Value:** 200 ppm
5.5 **Short Term Inhalation Limits:** 260 mg/m³ for 60 min.
5.6 **Toxicity by Ingestion:** Grade 1; LD_{oo} = 5 to 15 g/kg (rat)
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 100 ppm
5.11 **IDLH Value:** 25,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 54°F C.C.; 61°F O.C.
6.2 **Flammable Limits in Air:** 6.0%-36.5%
6.3 **Fire Extinguishing Agents:** Alcohol foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Containers may explode.
6.7 **Ignition Temperature:** 867°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 1.7 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 20

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 250 ppm/11 hr/goldfish/died/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0.6 to 1.12 lb/lb in 5 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** CP, Crude, ACS: all 99.9%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	1
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 32.04
12.3 **Boiling Point at 1 atm:** 148.1°F = 64.5°C = 337.7°K
12.4 **Freezing Point:** —144.0°F = —97.8°C = 175.4°K
12.5 **Critical Temperature:** 464°F = 240°C = 513°K
12.6 **Critical Pressure:** 1142.0 psia = 77.7 atm = 7.87 MN/m²
12.7 **Specific Gravity:** 0.792 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** 1.1
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.254
12.12 **Latent Heat of Vaporization:** 473.0 Btu/lb = 262.8 cal/g = 11.00 X 10^5 J/kg
12.13 **Heat of Combustion:** —8419 Btu/lb = —4677 cal/g = —195.8 X 10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** (est.) —9 Btu/lb = —5 cal/g = —0.2 X 10^5 J/kg
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 23.70 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 4.5 psia

NOTES

MAL

METHYL ALCOHOL

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
15	51.110
20	50.950
25	50.790
30	50.630
35	50.470
40	50.310
45	50.150
50	49.990
55	49.830
60	49.670
65	49.510
70	49.350
75	49.190
80	49.030
85	48.870
90	48.710
95	48.550
100	48.390

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
60	.576
70	.593
80	.611
90	.629
100	.647
110	.665
120	.682
130	.700
140	.718

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
65	1.389
70	1.384
75	1.379
80	1.374
85	1.369
90	1.364
95	1.360
100	1.355
105	1.350
110	1.345
115	1.340
120	1.335
125	1.330
130	1.325

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise
	N
	O
	T
	P
	E
	R
	T
	I
	N
	E
	N
	T

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
	M
	I
	S
	C
	I
	B
	L
	E

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
20	.377
30	.537
40	.753
50	1.044
60	1.428
70	1.930
80	2.579
90	3.412
100	4.467
110	5.795
120	7.450
130	9.496
140	12.010
150	15.070
160	18.770
170	23.210

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
20	.00235
30	.00327
40	.00450
50	.00611
60	.00820
70	.01087
80	.01427
90	.01852
100	.02383
110	.03036
120	.03836
130	.04807
140	.05976
150	.07376
160	.09039
170	.11000

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.280
25	.289
50	.299
75	.309
100	.319
125	.328
150	.338
175	.348
200	.359
225	.369
250	.379
275	.390
300	.400
325	.411
350	.422
375	.432
400	.443
425	.454
450	.466
475	.477
500	.488
525	.500
550	.511
575	.523
600	.534

NITRIC ACID

NAC

Common Synonyms	Watery liquid	Colorless to light brown	Choking odor
	Sinks and mixes with water. Harmful vapor is produced.		

AVOID CONTACT WITH LIQUID AND VAPOR. Keep people away.
Wear chemical protective suit with self-contained breathing apparatus.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
May cause fire on contact with combustibles.
Flammable gas may be formed on contact with metals.
Poisonous gases are produced when heated.
Wear chemical protective suit with self-contained breathing apparatus.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Will burn eyes, nose and throat.
If inhaled, will cause difficult breathing or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-corrosive
Restrict access
Evacuate area
Disperse and flush

2. LABEL

2.1 **Category:** Oxidizer; Corrosive
2.2 **Class:** 5 & 8

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Nitric acid
3.2 **Formula:** HNO_3-H_2O
3.3 **IMO/UN Designation:** 8.0/2031
3.4 **DOT ID No.:** 2031
3.5 **CAS Registry No.:** 7697-37-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Acrid; sweet to acrid

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Air mask; rubber acid suit, hood, boots and gloves; chemical goggles; safety shower and eye bath.
5.2 **Symptoms Following Exposure:** Vapors irritate eyes and respiratory tract; lung injury may not become apparent for several hours following exposure. Liquid may cause severe burns to eyes and skin.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air, administer artificial respiration if required. INGESTION: drink large volumes of water; do NOT induce vomiting. SKIN OR EYES: flush with water for at least 15 min.
5.4 **Threshold Limit Value:** 2 ppm
5.5 **Short Term Inhalation Limits:** 15 ppm for 5 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** 58-68%: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations. 95%: Vapors cause severe irritation of eye and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.
5.9 **Liquid or Solid Irritant Characteristics:** Severe skin irritant. Causes second and third-degree burns on short contact and is very injurious to the eyes.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** 100 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Use water on adjacent fires.
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** May give off poisonous oxides of nitrogen and acid fumes when heated in fires.
6.6 **Behavior in Fire:** Decomposes and gives off poisonous oxides of nitrogen.
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** May heat up on mixing, but explosion or formation of steam unlikely.
7.2 **Reactivity with Common Materials:** Very corrosive to wood, paper, cloth and most metals. Toxic red oxides of nitrogen are formed.
7.3 **Stability During Transport:** When heated may give off toxic red oxides of nitrogen.
7.4 **Neutralizing Agents for Acids and Caustics:** Flush with water
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 3

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 72 ppm/96 hr/mosquito fish/TL_m/fresh water
330-1000 ppm/48 hr/cockle/LC_{50}/salt water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Various grades: 52-98%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Oxidizer
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	0
Health	
Vapor Irritant	3
Liquid or Solid Irritant	4
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	4
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	0
	oxy

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** Not pertinent
12.3 **Boiling Point at 1 atm:** 192.0°F = 88.9°C = 362.1°K
12.4 **Freezing Point:** —50°F = —45.6°C = 227.6°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.49 at 20°C (liquid)
12.8 **Liquid Surface Tension:** Not pertinent
12.9 **Liquid Water Interfacial Tension:** Not pertinent
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** (est.) 1.248
12.12 **Latent Heat of Vaporization:** 214 Btu/lb = 119 cal/g = 4.98 X 10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** —205 Btu/lb = —114 cal/g = —4.76 X 10^5 J/kg
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 1.9 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

NITRIC ACID

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
35	95.139	51	.470		N		N
40	94.830	52	.471		O		O
45	94.520	53	.472		T		T
50	94.209	54	.472				
55	93.910	55	.473		P		P
60	93.599	56	.473		E		E
65	93.290	57	.474		R		R
70	92.990	58	.474		T		T
75	92.679	59	.475		I		I
80	92.370	60	.475		N		N
85	92.070	61	.476		E		E
90	91.759	62	.477		N		N
95	91.450	63	.477		T		T
		64	.478				
		65	.478				
		66	.479				
		67	.479				
		68	.480				
		69	.480				
		70	.481				
		71	.482				
		72	.482				
		73	.483				
		74	.483				
		75	.484				
		76	.484				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	M	80	1.291	80	.01404	0	.206
	I	85	1.489	85	.01605	10	.209
	S	90	1.713	90	.01829	20	.213
	C	95	1.964	95	.02078	30	.216
	I	100	2.246	100	.02355	40	.219
	B	105	2.560	105	.02662	50	.223
	L	110	2.912	110	.03000	60	.226
	E	115	3.303	115	.03374	70	.229
		120	3.737	120	.03784	80	.232
		125	4.218	125	.04235	90	.236
		130	4.750	130	.04728	100	.239
		135	5.336	135	.05267	110	.242
		140	5.981	140	.05855	120	.246
		145	6.690	145	.06494	130	.249
		150	7.467	150	.07189	140	.252
		155	8.317	155	.07943	150	.255
		160	9.246	160	.08758	160	.259
		165	10.260	165	.09640	170	.262
		170	11.360	170	.10590	180	.265
		175	12.560	175	.11610	190	.269
		180	13.860	180	.12720	200	.272
						210	.275
						220	.278
						230	.282
						240	.285
						250	.288

OHS14371

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000

CAS NUMBER: 71-55-6
RTECS NUMBER: KJ2975000

SUBSTANCE: 1,1,1-TRICHLOROETHANE, STABILIZED

TRADE NAMES/SYNONYMS:
1,1,1-TRICHLOROETHANE; ALPHA-TRICHLOROETHANE; INHIBISOL;
METHYLTRICHLOROMETHANE; METHYL CHLOROFORM; TRICHLOROMETHYLMETHANE;
TRICHLOROETHANE; ETHANE, 1,1,1-TRICHLORO-; CHLORTEN; 1,1,1-TRICHLORETHANE;
TRICHLOROETHANE 111 DEGREASE COLD/VAPOR (ASHLAND);
ST-1000A CLEANER (STRESSCOAT); BLACO-THANE (BARON-BLAKESLEE);
PERM ETHANE DG (DETREX CHEMICALS); SAFETY SOLVENT (LOCTITE CORPORATION);
ACTIVATOR 711, 702, 703 (LOCTITE CORPORATION); STCC 4941176; RCRA U226;
UN 2831; C2H3CL3; OHS14371

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

CREATION DATE: 05/24/90 REVISION DATE: 07/14/93

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : 1,1,1-TRICHLOROETHANE
CAS NUMBER: 71-55-6
PERCENTAGE: 94.0-98.0

COMPONENT : 1,4-DIOXANE
CAS NUMBER: 123-91-1
PERCENTAGE: 0.0-4.0

OTHER CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:
1,1,1-TRICHLOROETHANE, STABILIZED IS A CLEAR LIQUID WITH A MILD, SWEET ODOR.
SUSPECT CANCER HAZARD (CONTAINS MATERIAL WHICH CAN CAUSE CANCER IN ANIMALS).
RISK OF CANCER DEPENDS ON DURATION AND LEVEL OF EXPOSURE. MAY CAUSE LIVER

DAMAGE. MAY DAMAGE KIDNEYS. MAY AFFECT THE CENTRAL NERVOUS SYSTEM. CAUSES RESPIRATORY TRACT, SKIN AND EYE IRRITATION. NO KNOWN FIRE OR REACTIVITY HAZARD.
AVOID BREATHING VAPOR OR MIST. AVOID CONTACT WITH EYES, SKIN AND CLOTHING. KEEP CONTAINER TIGHTLY CLOSED. WASH THOROUGHLY AFTER HANDLING. USE ONLY WITH ADEQUATE VENTILATION.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE DRUNKENESS, TEARING, DROOLING, NAUSEA, VOMITING, DIARRHEA, DIFFICULTY BREATHING, IRREGULAR HEARTBEAT, HEADACHE, WEAKNESS, DROWSINESS, FEELING OF WELL-BEING, NUMBNESS, LIVER AND KIDNEY DAMAGE, LUNG, LIVER AND KIDNEY DAMAGE, CONVULSIONS, UNCONSCIOUSNESS AND COMA.
LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, LACK OF APPETITE, INABILITY TO URINATE, LUNG DAMAGE AND LIVER ENLARGEMENT MAY OCCUR. MAY ALSO CAUSE REPRODUCTIVE EFFECTS.
SKIN CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE DRUNKENESS, NAUSEA, VOMITING, HEADACHE AND LIVER AND KIDNEY DAMAGE.
LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, BURNS MAY OCCUR.
EYE CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE EYE DAMAGE.
LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.
INGESTION:
SHORT TERM EXPOSURE: MAY CAUSE DRUNKENESS, LIVER DAMAGE, KIDNEY DAMAGE, VOMITING, DIGESTIVE DISORDERS, HEADACHE, WEAKNESS, CONFUSION, LUNG DAMAGE, UNCONSCIOUSNESS, COMA AND HEART FAILURE.
LONG TERM EFFECTS: MAY CAUSE SORES. MAY ALSO CAUSE REPRODUCTIVE EFFECTS AND CANCER.
ADDITIONAL DATA: DRINKING ALCOHOL MAY WORSEN THE EFFECTS.

CARCINOGEN STATUS:
OSHA: N
NTP: Y
IARC: Y

SECTION 4 FIRST AID MEASURES

INHALATION:
FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO

EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE. OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION AND ADVICE ON WHETHER TO USE GASTRIC LAVAGE. EXTREME CARE MUST BE TAKEN TO PREVENT ASPIRATION. A CUFFED ENDOTRACHEAL TUBE USED BY QUALIFIED MEDICAL PERSONNEL MIGHT BE ADVISABLE. KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION SHOULD VOMITING OCCUR.

NOTE TO PHYSICIAN
ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

EXTINGUISHING MEDIA:
DRY CHEMICAL OR CARBON DIOXIDE
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR REGULAR FOAM
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. ISOLATE FOR 1/2 MILE IN ALL DIRECTIONS IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN FIRE (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 74).

EXTINGUISH USING AGENTS FOR SURROUNDING FIRE. COOL FIRE-EXPOSED CONTAINERS WITH FLOODING AMOUNTS OF WATER APPLIED FROM AS FAR A DISTANCE AS POSSIBLE. DO NOT ALLOW RUN-OFF WATER INTO SEWERS AND WATER SOURCES. AVOID BREATHING VAPORS.

FLASH POINT: NOT AVAILABLE

HAZARDOUS COMBUSTION PRODUCTS:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC AND CORROSIVE FUMES OF CHLORIDES, TOXIC FUMES OF PHOSGENE AND CHLOROACETYLENES, AND OXIDES OF CARBON.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL

LIQUID SPILLS. TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

SOIL SPILL:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

WATER SPILL:
LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS.

TRAP SPILLED MATERIAL AT BOTTOM IN DEEP WATER POCKETS, EXCAVATED HOLDING AREAS OR WITHIN SAND BAG BARRIERS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

THE CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (PROPOSITION 65) PROHIBITS CONTAMINATING ANY KNOWN SOURCE OF DRINKING WATER WITH SUBSTANCES KNOWN TO CAUSE CANCER AND/OR REPRODUCTIVE TOXICITY.

SECTION 7 HANDLING AND STORAGE

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING THIS SUBSTANCE.

STORE IN A COOL, DRY, WELL-VENTILATED LOCATION (NFPA 49, HAZARDOUS CHEMICALS DATA, 1991).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
350 PPM (1910 MG/M3) OSHA TWA; 450 PPM (2460 MG/M3) OSHA STEL
350 PPM (1910 MG/M3) ACGIH TWA; 450 PPM (2460 MG/M3) ACGIH STEL
350 PPM (1910 MG/M3) NIOSH RECOMMENDED 15 MINUTE CEILING
200 PPM (1080 MG/M3) DFG MAK TWA;
1000 PPM (5400 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 2 TIMES/SHIFT

MEASUREMENT METHOD: CHARCOAL TUBE; CARBON DISULFIDE; GAS CHROMATOGRAPHY WITH FLAME IONIZATION DETECTION; (NIOSH VOL. III # 1003, HALOGENATED

HYDROCARBONS).

1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

1,4-DIOXANE:
25 PPM (90 MG/M3) OSHA TWA (SKIN)
25 PPM (90 MG/M3) ACGIH TWA (SKIN)
1 PPM (3.6 MG/M3) NIOSH RECOMMENDED 30 MINUTE CEILING
50 PPM (180 MG/M3) DFG MAK TWA (SKIN);
100 PPM (360 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 4 TIMES/SHIFT

MEASUREMENT METHOD: CHARCOAL TUBE; CARBON DISULFIDE; GAS CHROMATOGRAPHY WITH FLAME IONIZATION DETECTION; (NIOSH VOL. III # 1602).

100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY WARNING AND RELEASE REQUIREMENTS- (JANUARY 1, 1988)

OSHA REVOKED THE FINAL RULE LIMITS OF JANUARY 19, 1989 IN RESPONSE TO THE 11TH CIRCUIT COURT OF APPEALS DECISION (AFL-CIO V. OSHA) EFFECTIVE JUNE 30, 1993. SEE 29 CFR 1910.1000 (58 FR 35338)

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):

1000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

ESCAPE- ANY AIR-PURIFYING, FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE, SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

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.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: CLEAR, COLORLESS LIQUID WITH A MILD CHLOROFORM-LIKE ODOR.
MOLECULAR WEIGHT: 133.40
MOLECULAR FORMULA: C-H3-C-CL3
BOILING POINT: 160-190 F (71-88 C)
MELTING POINT: -58 F (-50 C)
VAPOR PRESSURE: 134 MMHG @ 20 C
VAPOR DENSITY: 4.6
SPECIFIC GRAVITY: 1.29-1.33
WATER SOLUBILITY: <5%
VOLATILITY: 100%
EVAPORATION RATE: (BUTYL ACETATE=1) 1.0
SOLVENT SOLUBILITY: SOLUBLE IN ACETONE, BENZENE, CHLOROFORM, METHANOL, ETHANOL, CARBON DISULFIDE, ETHER, CARBON TETRACHLORIDE, N-HEPTANE.

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
SLOWLY DECOMPOSES OVER TIME YIELDING HYDROGEN CHLORIDE. AN INHIBITOR MAY BE ADDED TO SCAVENGE THE ACID THAT IS FORMED AND PREVENT CORROSION TO METALS. WATER MAY REACT WITH THE INHIBITOR AND ALLOW THE NATURAL DECOMPOSITION TO OCCUR.

CONDITIONS TO AVOID:
MAY BURN BUT DOES NOT IGNITE READILY. CONTAINER MAY EXPLODE IN HEAT OF FIRE.

INCOMPATIBILITIES:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
ACETONE: EXOTHERMIC REACTION.
ALKALI (STRONG): POSSIBLE VIOLENT REACTION.
ALUMINUM AND ALLOYS: MAY DECOMPOSE VIOLENTLY.

BARIUM: FIRE AND EXPLOSION HAZARD.
MAGNESIUM: VIOLENT DECOMPOSITION WITH EVOLUTION OF HYDROGEN CHLORIDE.
METALS (POWDERED): FIRE AND EXPLOSION HAZARD.
NITROGEN TETROXIDE: FORMS EXPLOSIVE MIXTURE.
OXIDIZERS (STRONG): POSSIBLE VIOLENT REACTION.
OXYGEN (GAS): POSSIBLE EXPLOSION WHEN HEATED @ 100 C.
OXYGEN (LIQUID): POSSIBLE VIOLENT EXPLOSION.
POTASH: FORMS FLAMMABLE OR EXPLOSIVE PRODUCT.
POTASSIUM AND ALLOYS: FORMS SHOCK-SENSITIVE MIXTURE.
POTASSIUM HYDROXIDE: FORMATION OF SPONTANEOUSLY FLAMMABLE PRODUCT.
RUBBER, PLASTICS, COATINGS: MAY BE ATTACKED.
SODIUM AND ALLOYS: FIRE AND EXPLOSION HAZARD.
SODIUM HYDROXIDE: FORMS SPONTANEOUSLY FLAMMABLE PRODUCT.
SODIUM-POTASSIUM ALLOY: POSSIBLE EXPLOSION.
TIN AND ALLOYS: INCOMPATIBLE.
ZINC AND ALLOYS: INCOMPATIBLE.

1,4-DIOXANE:
DECABORANE: FORMS SHOCK-SENSITIVE MIXTURE.
NICKEL (RANEY CATALYST): POSSIBLE EXPLOSIVE REACTION ABOVE 210 C.
NITRIC ACID + PERCHLORIC ACID: POSSIBLE EXPLOSIVE REACTION.
OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
SILVER PERCHLORATE: MAY FORM EXPLOSIVE COMPOUND.
SULFUR TRIOXIDE: VIOLENT DECOMPOSITION ON STORAGE.
TRIETHYNYLALUMINUM: MAY EXPLODE WHEN HEATED.
SEE ALSO ETHERS.

HAZARDOUS DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC AND CORROSIVE FUMES OF CHLORIDES, TOXIC FUMES OF PHOSGENE AND CHLOROACETYLENES, AND OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
IRRITATION DATA: 450 PPM/6 HOURS EYE-MAN; 5 GM/12 DAYS INTERMITTENT SKIN-RABBIT MILD; 20 MG/24 HOURS SKIN-RABBIT MODERATE; 100 MG EYE-RABBIT MILD; 2 MG/24 HOURS EYE-RABBIT SEVERE.
TOXICITY DATA: 350 PPM INHALATION-MAN TCLO; 200 PPM/4 HOURS INHALATION-MAN TCLO; 920 PPM/70 MINUTES INHALATION-HUMAN TCLO; 18000 PPM/4 HOURS INHALATION-RAT LC50; 10000 PPM/1 HOUR/13 WEEKS INTERMITTENT INHALATION-RAT TCLO; 3911 PPM/2 HOURS INHALATION-MOUSE LC50; 1000 PPM/1 HOUR/13 WEEKS INTERMITTENT INHALATION-GUINEA PIG; 24400 MG/M3 INHALATION-CAT LC50; 15800 MG/KG SKIN-RABBIT LD50 (EPA-600/8-82-003F, 1084); >5 GM/KG SKIN-RABBIT LD50; 670 MG/KG ORAL-HUMAN TDLO; 10300 MG/KG ORAL-RAT LD50; 11240 MG/KG ORAL-MOUSE LD50; 5660 MG/KG ORAL-RABBIT LD50; 9470 MG/KG ORAL-GUINEA PIG LD50; 750 MG/KG ORAL-DOG LD50; 16 GM/KG SUBCUTANEOUS-MOUSE LD50; 500 MG/KG SUBCUTANEOUS-RABBIT LDLO; 95 MG/KG INTRAVENOUS-DOG LDLO; 3593 MG/KG INTRAPERITONEAL-RAT LD50; 3636 MG/KG INTRAPERITONEAL-MOUSE LD50; 3100 MG/KG INTRAPERITONEAL-DOG LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA

(RTECS).
CARCINOGEN STATUS: ANIMAL INADEQUATE EVIDENCE (IARC GROUP-3).
LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYE.
ACUTE TOXICITY LEVEL: SLIGHTLY TOXIC BY INHALATION, DERMAL ABSORPTION AND INGESTION.
TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY ALSO AFFECT THE HEART, LIVER AND KIDNEYS.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH PRE-EXISTING SKIN DISORDERS OR LIVER, KIDNEY, OR CARDIOVASCULAR DISEASE.
ADDITIONAL DATA: ALCOHOL MAY ENHANCE THE TOXIC EFFECTS. STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

1,4-DIOXANE:
IRRITATION DATA: 515 MG OPEN SKIN-RABBIT MILD; 300 PPM/15 MINUTES EYE-HUMAN; 100 MG EYE-RABBIT SEVERE; 100 MG/24 HOURS EYE-RABBIT MODERATE; 10 UG EYE-GUINEA PIG MODERATE.
TOXICITY DATA: 470 PPM INHALATION-HUMAN TCLO; 5500 PPM/1 MINUTE INHALATION-HUMAN TCLO; 470 PPM/3 DAYS INHALATION-HUMAN LCLO; 46 GM/M3/2 HOURS INHALATION-RAT LC50; 37 GM/M3/2 HOURS INHALATION-MOUSE LC50; 44 GM/M3/7 HOURS INHALATION-CAT LCLO; 20520 MG/M3 INHALATION-MAMMAL LC50; 6000 PPM/4 HOURS/2 WEEKS-INTERMITTENT INHALATION-RAT TCLO; 7600 MG/KG SKIN-RABBIT LD50; 2 GM/KG ORAL-RABBIT LD50; 5700 MG/KG ORAL-MOUSE LD50; 2 GM/KG ORAL-CAT LD50; 3150 MG/KG ORAL-GUINEA PIG LD50; 1500 MG/KG INTRAVENOUS-RABBIT LDLO; 1500 MG/KG INTRAVENOUS-CAT LDLO; 790 MG/KG INTRAPERITONEAL-MOUSE LD50; 799 MG/KG INTRAPERITONEAL-RAT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS).
CARCINOGEN STATUS: ANTICIPATED HUMAN CARCINOGEN (NTP); HUMAN INADEQUATE EVIDENCE, ANIMAL SUFFICIENT EVIDENCE (IARC GROUP-2B). ORAL ADMINISTRATION PRODUCED ADENOMAS AND CARCINOMAS IN THE LIVER AND CARCINOMAS OF THE NASAL CAVITY IN RATS AND HEPATOMAS AND CARCINOMAS OF THE GALL BLADDER IN GUINEA PIGS.
LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYES.
ACUTE TOXICITY LEVEL: MODERATELY TOXIC BY INHALATION; SLIGHTLY TOXIC BY DERMAL ABSORPTION AND INGESTION.
TARGET EFFECTS: HEPATOTOXIN; CENTRAL NERVOUS SYSTEM DEPRESSANT: NEPHROTOXIN. POISONING MAY AFFECT THE BRAIN.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH PRE-EXISTING LIVER, KIDNEY, PULMONARY OR SKIN DISORDERS.
ADDITIONAL DATA: ALCOHOL MAY ENHANCE THE TOXIC EFFECTS.

HEALTH EFFECTS
INHALATION:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
IRRITANT/NARCOTIC. 1000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- EXPOSURE TO 500 PPM FOR 60 MINUTES SHOULD CAUSE NO EFFECT EXCEPT FOR A DISTINCTIVE ODOR WHILE 900-1000 PPM FOR 20 MINUTES MAY CAUSE MILD RESPIRATORY TRACT IRRITATION AND PROMPT BUT MINIMAL IMPAIRMENT OF EQUILIBRIUM WHICH MAY BE ACCOMPANIED BY HEADACHE, LASSITUDE AND ATAXIA. IMPAIRED PERFORMANCE OF BEHAVIORAL TESTS WAS ALSO REPORTED AT 1000 PPM. HIGHER LEVELS OF 2000-5000 PPM MAY CAUSE INCOORDINATION, ANESTHESIA, EUPHORIA, LOSS OF CONSCIOUSNESS, COMA AND DEATH DUE TO CENTRAL NERVOUS SYSTEM DEPRESSION, RESPIRATORY ARREST, OR CARDIAC ARRYTHMIA. CARDIAC SENSITIZATION MAY BE A CONTRIBUTING FACTOR. OTHER EFFECTS MAY INCLUDE NAUSEA, VOMITING, DIARRHEA, DROWSINESS, CONVULSIONS, FALL OF BLO

PRESSURE, LIVER AND KIDNEY DAMAGE, BRADYCARDIA AND BLOOD CLOTTING CHANGES.
CHRONIC EXPOSURE- NO ADVERSE EFFECTS RELATED TO EXPOSURE WERE REPORTED IN VOLUNTEERS EXPOSED TO 500 PPM FOR 7 HOURS A DAY FOR 5 DAYS, OR IN WORKERS EXPOSED TO 200 PPM FOR SEVERAL MONTHS TO 6 YEARS. THERE IS SOME EVIDENCE FROM HUMAN CASE REPORTS THAT REPEATED EXPOSURE TO HIGH CONCENTRATIONS MAY CAUSE LASTING DAMAGE TO THE HEART. EXPOSURE OF ANIMALS FOR 3 MONTHS AT CONCENTRATIONS FROM 1000 TO 10,000 PPM CAUSED SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION AND SOME PATHOLOGICAL CHANGES IN THE LIVERS AND LUNGS OF SOME SPECIES. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

1,4-DIOXANE:
IRRITANT/NARCOTIC/HEPATOTOXIN/NEPHROTOXIN.
ACUTE EXPOSURE- MAY BE IRRITATING TO THE NOSE, THROAT AND RESPIRATORY TRACT AT 220 PPM. THIS COMPOUND HAS POOR WARNING PROPERTIES AND CAN BE INHALED IN AMOUNTS THAT MAY CAUSE SERIOUS SYSTEMIC INJURY. SYMPTOMS OF SYSTEMIC TOXICITY MAY INCLUDE HEADACHE, VERTIGO, DROWSINESS, DYSPNEA, NAUSEA, AND VOMITING. INHALATION CAUSED INCREASED SALIVATION, LACRIMATION, NARCOSIS, BEHAVIORAL CHANGES, AND DEATH IN ANIMALS. AUTOPSY REVEALED LUNG, LIVER AND KIDNEY DAMAGE, CONGESTION AND EDEMA OF THE LUNGS, AND INCREASED BLOOD COUNTS.
CHRONIC EXPOSURE- REPEATED EXPOSURE CAUSED MUCOUS MEMBRANE IRRITATION, DYSPNEA, HEADACHE, VERTIGO, LOSS OF APPETITE, NAUSEA AND VOMITING, PAIN AND TENDERNESS IN THE ABDOMEN AND LUMBAR REGION, DROWSINESS, MALAISE, LIVER ENLARGEMENT AND DAMAGE, OLIGURIA, ANURIA, UREMIA, COMA, AND DEATH FROM ACUTE RENAL FAILURE. AUTOPSIES REVEALED LUNG AND BRAIN CONGESTION, CENTRAL NERVOUS SYSTEM DAMAGE, LIVER NECROSIS, HEMORRHAGIC NEPHRITIS AND NECROSIS, LEUKOCYTOSIS, AND BRONCHOPNEUMONIA.

SKIN CONTACT:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE IRRITATION AND REDNESS. VAPORS ARE POORLY ABSORBED, BUT THE LIQUID, ESPECIALLY IF CONFINED UNDER AN IMPERMEABLE BARRIER MAY BE ABSORBED TO SOME EXTENT. THIS ALONE IS UNLIKELY TO RESULT IN TOXIC EFFECTS, BUT MAY ADD TO THE EFFECTS OF INHALATION EXPOSURE.
CHRONIC EXPOSURE- REPEATED SKIN CONTACT MAY PRODUCE A DRY, SCALY, FISSURED DERMATITIS DUE TO THE DEFATTING PROPERTIES OF THE LIQUID, AND POSSIBLY BURNS.

1,4-DIOXANE:
IRRITANT/NARCOTIC/HEPATOTOXIN/NEPHROTOXIN.
ACUTE EXPOSURE- MAY CAUSE IRRITATION WITH REDNESS AND PAIN. ALLERGIC CONTACT DERMATITIS HAS BEEN REPORTED. SKIN ABSORPTION MAY OCCUR AND CAUSE HEADACHE, NAUSEA AND VOMITING. SKIN ABSORPTION PRODUCED SIGNS OF UNSTEADINESS, INCOORDINATION, NARCOSIS, ERYTHEMA, AND LIVER AND KIDNEY DAMAGE IN ANIMALS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED CONTACT MAY CAUSE DRYING AND CRACKING OF THE SKIN, DERMATITIS, AND ECZEMA. SKIN ABSORPTION MAY HAVE CONTRIBUTED TO THE DEATH OF A WORKER FOLLOWING SKIN AND INHALATION EXPOSURE FOR ONE WEEK. ANIMAL STUDIES INDICATE REPEATED SKIN APPLICATION MAY RESULT IN LIVER AND KIDNEY DAMAGE. TUMOR PROMOTER ACTIVITY HAS BEEN REPORTED IN MICE.

EYE CONTACT:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
IRRITANT.
ACUTE EXPOSURE- EXPOSURE TO 500 PPM MAY CAUSE IRRITATION AND REDNESS. DIRECT CONTACT WITH THE LIQUID MAY CAUSE TEMPORARY INJURY WITH COMPLETE RECOVERY EXPECTED IN 48 HOURS. DIRECT APPLICATION TO THE EYES OF RABBITS HAS CAUSED CONJUNCTIVAL IRRITATION, BUT NO CORNEAL DAMAGE.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

1,4-DIOXANE:
IRRITANT.
ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION AT CONCENTRATIONS ABOVE 200 PP NO SERIOUS DISTURBANCES HAVE BEEN REPORTED BY EXTERNAL CONTACT. DIRECT APPLICATION TO RABBIT EYES CAUSED TRANSIENT CORNEAL INJURY.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY RESULT IN CONJUNCTIVITIS.

INGESTION:
METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE):
NARCOTIC.
ACUTE EXPOSURE- MAY CAUSE NAUSEA, VOMITING, DIARRHEA, GASTROINTESTINAL DISTURBANCES AND ABDOMINAL PAIN FOLLOWED BY CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, WEAKNESS, INCOORDINATION, MENTAL CONFUSION AND UNCONSCIOUSNESS. DEATH MAY OCCUR FROM CHRONIC RESPIRATORY FAILURE. OTHER SYMPTOMS AS DESCRIBED IN ACUTE INHALATION MAY ALSO OCCUR. MYOCARDIAL SENSITIZATION TO EPINEPHRINE AND SUBSEQUENT DEATH DUE TO CARDIAC ARREST MAY OCCUR. ASPIRATION MAY RESULT IN PULMONARY EDEMA OR CHEMICAL PNEUMONITIS.
CHRONIC EXPOSURE- REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

1,4-DIOXANE:
NARCOTIC/HEPATOTOXIN/NEPHROTOXIN/CARCINOGEN.
ACUTE EXPOSURE- MAY CAUSE LIGHT BURNING SENSATION ON CONTACT WITH ORAL MUCOUS MEMBRANES. LARGE DOSES RESULTED IN WEAKNESS, INCOORDINATION, DEPRESSION, COMA AND DEATH IN ANIMALS. AUTOPSY REVEALED HEMORRHAGIC AREAS IN THE PYLORIC REGION OF THE STOMACH, BLADDERS DISTENDED WITH URINE, SLIGHT PROTEINURIA AND ENLARGED KIDNEYS. ASPIRATION MAY RESULT IN PNEUMONIA.
CHRONIC EXPOSURE- IN ANIMAL FEEDING STUDIES, THIS COMPOUND PRODUCED LIVER AND KIDNEY DEGENERATION AND NECROSIS, ULCERATION OF THE STOMACH, HEPATOMAS, CARCINOMA OF THE NASAL CAVITY, CARCINOMA OF THE KIDNEY PELVIS, LEUKEMIA, LYMPHOSARCOMA, CHOLANGIOMAS, GALL BLADDER CARCINOMAS, AND TUMORS OF THE LUNG. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40CFR 262, EPA HAZARDOUS WASTE NUMBER U226.

US EPA RCRA HAZARDOUS WASTE NUMBER: RCRA U226

SECTION 14 TRANSPORTATION INFORMATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND SUBPART E:
NONE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.6Ø5
EXCEPTIONS: 49-CFR 173.5Ø5

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-18Ø), DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-2Ø4. EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/9Ø)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARDS, AND INFECTIOUS SUBSTANCES, THE EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO OCTOBER 1, 1993. (56 FR 47158, Ø9/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
1,1,1-TRICHLOROETHANE-UN 2831

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
6.1 - POISONOUS MATERIALS

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG III

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
KEEP AWAY FROM FOOD

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.153
NON-BULK PACKAGING: 49 CFR 173.2Ø3

BULK PACKAGING: 49 CFR 173.241

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 60 L
CARGO AIRCRAFT ONLY: 220 L

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	100 POUNDS RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	Y	

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16 OTHER

OHS06100

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000

CAS NUMBER: 2691-41-0
RTECS NUMBER: XF7450000

SUBSTANCE: CYCLOTETRAMETHYLENETETRANITRAMINE

TRADE NAMES/SYNONYMS:
OCTAHYDRO-1,3,5,7,-TETRANITRO-1,3,5,7,-TETRAZOCINE; HMX; BETA-HMX;
HOMOCYCLONITE; OCTOGEN; 1,3,5,7-TETRAZOCINE, OCTAHYDRO-1,3,5,7-TETRANITRO-;
TETRAMETHYLENETETRANITRAMINE; CYCLOTETRAMETHYLENE TETRANITRAMINE;
1,3,5,7-TETRANITROPERHYDRO-1,3,5,7-TETRAZOCINE; STCC 4901548; UN 0226;
CYCLOTETRAMETHYLENE TETRANITRAMINE, WET WITH NOT LESS THAN 10% WATER;
C4H8N8O8; OHS06100

CHEMICAL FAMILY:
AMINE, ALICYCLIC

NITRO

CREATION DATE: 06/30/86 REVISION DATE: 03/24/93

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : CYCLOTETRAMETHYLENETETRANITRAMINE
CAS NUMBER: 2691-41-0
PERCENTAGE: <90

COMPONENT : WATER
PERCENTAGE: >10

OTHER CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=3 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=4 REACTIVITY=4

EMERGENCY OVERVIEW:
CYCLOTETRAMETHYLENETETRANITRAMINE IS A SOLID.
HARMFUL IF ABSORBED THROUGH SKIN. MAY EXPLODE FROM HEAT, SHOCK OR FRICTION.
MAY FORM FLAMMABLE OR EXPLOSIVE DUST-AIR MIXTURES.
DO NOT GRIND OR SUBJECT TO HEAT OR SHOCK. KEEP AWAY FROM ALL IGNITION SOURCES.

AVOID CONTACT WITH EYES, SKIN AND CLOTHING. AVOID CONTAMINATION BY ANY SOURCE. AVOID DISPERSION OF DUST. WASH THOROUGHLY AFTER HANDLING.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: NO INFORMATION IS AVAILABLE.
LONG TERM EFFECTS: NO INFORMATION IS AVAILABLE.
SKIN CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE DEATH.
LONG TERM EFFECTS: MAY CAUSE REDNESS AND SWELLING OF THE SKIN AND SHOCK.
EYE CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.
LONG TERM EFFECTS: NO INFORMATION IS AVAILABLE.
INGESTION:
SHORT TERM EXPOSURE: MAY CAUSE DRUNKENESS.
LONG TERM EFFECTS: NO INFORMATION IS AVAILABLE.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION:
FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE. OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
FIRST AID- TREAT SYMPTONATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION.

NOTE TO PHYSICIAN
ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

DANGEROUS EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

DUST-AIR MIXTURES MAY IGNITE OR EXPLODE.

EXTINGUISHING MEDIA:
FLOOD WITH WATER. IF NO WATER AVAILABLE USE CARBON DIOXIDE, DRY CHEMICAL OR EARTH
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
DO NOT MOVE CONTAINERS IF EXPOSURE TO HEAT HAS OCCURRED. DO NOT FIGHT FIRE WHEN IT REACHES STORAGE OR CARGO AREA. WITHDRAW FROM AREA AND LET FIRE BURN. IF POSSIBILITY EXISTS THAT CLASS A EXPLOSIVES ARE INVOLVED, EVACUATE TO A DISTANCE OF 3/4 MILE FOR TRACTOR/TRAILER LOAD; 1 MILE FOR A RAILCAR LOAD. (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5. GUIDE PAGE 46).

DANGEROUSLY EXPLOSIVE. DO NOT FIGHT FIRE IN CARGO AREA. EVACUATE AREA AND LET BURN.

HAZARDOUS COMBUSTION PRODUCTS:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. EVACUATE AREA FOR 2500 FEET IN ALL DIRECTIONS. KEEP UNNECESSARY PEOPLE AWAY.

SECTION 7 HANDLING AND STORAGE

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING THIS SUBSTANCE.

STORE IN ACCORDANCE WITH 27 CFR SUBPART K AND 29 CFR 1910.109.

CONSULT NFPA PUBLICATION 495, EXPLOSIVES, STORAGE AND USE, FOR PROPER STORAGE AND HANDLING REQUIREMENTS.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
NO OCCUPATIONAL EXPOSURE LIMITS ESTABLISHED BY OSHA, ACGIH, OR NIOSH.

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST BE BASED ON THE SPECIFIC OPERATION, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND MUST BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

ANY TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

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.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: COLORLESS TO WHITE CRYSTALS WETTED WITH WATER.
MOLECULAR WEIGHT : 296.20
MOLECULAR FORMULA: C4-H8-N8-O8
MELTING POINT: 527 F (275 C)
SPECIFIC GRAVITY: NOT AVAILABLE
WATER SOLUBILITY: INSOLUBLE

SOLVENT SOLUBILITY: SOLUBLE IN ACETONE; SPARINGLY SOLUBLE IN ETHER AND ETHANOL.

DEFLAGRATION POINT (VIOLENT DECOMPOSITION): 534-549 F (279-287 C)

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
CYCLOTETRAMETHYLENETETRANITRAMINE:
EXPOSURE TO HEAT, FRICTION OR SHOCK MAY INITIATE DETONATION.

CONDITIONS TO AVOID:
DO NOT ALLOW FIRE TO REACH CARGO AREA.

INCOMPATIBILITIES:
CYCLOTETRAMETHYLENETETRANITRAMINE:
MERCURY FULMINATE: MAY EASILY INITIATE AN EXPLOSION.
METAL AZIDES: MAY INITIATE DETONATION.
OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.

HAZARDOUS DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

CYCLOTETRAMETHYLENETETRANITRAMINE:
IRRITATION DATA: 500 MG SKIN-RABBIT MILD.
TOXICITY DATA: 630 MG/KG SKIN-RABBIT LD50; 6490 MG/KG ORAL-RAT LD50; 300 MG/KG ORAL-GUINEA PIG LD50; 1500 MG/KG ORAL-MOUSE LD50; 50 MG/KG ORAL-RABBIT LD50; 40 MG/KG INTRAVENOUS-DOG LDLO; 28 MG/KG INTRAVENOUS-GUINEA PIG LD50; 25 MG/KG INTRAVENOUS-RAT LD50; 10 MG/KG INTRAVENOUS-RABBIT LD50; 2700 MG/KG UNREPORTED ROUTE-MOUSE LD50; 7300 MG/KG UNREPORTED ROUTE-RAT LD50.
CARCINOGEN STATUS: NONE.
ACUTE TOXICITY LEVEL: TOXIC BY DERMAL ABSORPTION; SLIGHTLY TOXIC BY INGESTION.
TARGET EFFECTS: NO DATA AVAILABLE.

HEALTH EFFECTS
INHALATION:
CYCLOTETRAMETHYLENETETRANITRAMINE:
ACUTE EXPOSURE- NO DATA AVAILABLE.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

SKIN CONTACT:
CYCLOTETRAMETHYLENETETRANITRAMINE:
TOXIC.
ACUTE EXPOSURE- THE LETHAL DOSE REPORTED IN RABBITS WAS 630 MG/KG. THE SYMPTOMS WERE NOT REPORTED.

CHRONIC EXPOSURE- DERMATITIS AND CIRCULATORY COLLAPSE WITH CENTRAL NERVOUS SYSTEM DISTURBANCES HAVE BEEN REPORTED IN ANIMALS.

EYE CONTACT:
CYCLOTETRAMETHYLENETETRANITRAMINE:
ACUTE EXPOSURE- MAY CAUSE IRRITATION.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

INGESTION:
CYCLOTETRAMETHYLENETETRANITRAMINE:
ACUTE EXPOSURE- MAY CAUSE NARCOSIS.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBERS, D001 AND D003.
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

SECTION 14 TRANSPORTATION INFORMATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
CLASS A EXPLOSIVE

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND SUBPART E:
EXPLOSIVE A

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.61 TO 49-CFR 173.87
EXCEPTIONS: 49-CFR 173.65

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4): N
SARA SECTION 302 (40CFR355.30): N
SARA SECTION 304 (40CFR355.40): N
SARA SECTION 313 (40CFR372.65): N
OSHA PROCESS SAFETY (29CFR1910.119): N
CALIFORNIA PROPOSITION 65: N

SARA HAZARD CATEGORIES. SARA SECTIONS 311/312 (40 CFR 370.21)
ACUTE HAZARD: Y
CHRONIC HAZARD: N
FIRE HAZARD: Y
REACTIVITY HAZARD: Y
SUDDEN RELEASE HAZARD: Y

SECTION 16 OTHER

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OHS05990

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-613-366-2000

CAS NUMBER: 121-82-4
RTECS NUMBER: XY9450000

SUBSTANCE: CYCLOTRIMETHYLENETRINITRAMINE

TRADE NAMES/SYNONYMS:
1,3,5-TRIAZINE, HEXAHYDRO-1,3,5-TRINITRO-;
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE;
S-TRIAZINE, HEXAHYDRO-1,3,S-TRINITRO-; HEXAHYDRO-1,3,S-TRINITRO-S-TRIAZINE;
CYCLONITE; CYCLOTRIMETHYLENEN1TRAMINE; SYM-TRIMETHYLENETRINITRAMINE;
TRIMETHYLENETRINITRAMINE; HEXOGEN; RDX; T4; C3H6N6O6; OHS05990

CHEMICAL FAMILY:
AMINE, ALICYCLIC

NITRO

CREATION DATE: 06/27/86 REVISION DATE: 07/14/93

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : CYCLOTRIMETHYLENETRINITRAMINE
CAS NUMBER: 121-82-4
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=3 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=4

EMERGENCY OVERVIEW:
CYCLOTRIMETHYLENETRINITRAMINE IS A WHITE SOLID.
HARMFUL IF SWALLOWED. MAY EXPLODE FROM HEAT, SHOCK OR FRICTION.
DO NOT GRIND OR SUBJECT TO HEAT OR SHOCK. KEEP AWAY FROM HEAT, SPARKS AND
FLAME. AVOID CONTAMINATION BY ANY SOURCE. WASH THOROUGHLY AFTER HANDLING.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.

LONG TERM EFFECTS: MAY CAUSE NAUSEA, VOMITING, HEADACHE, WEAKNESS, DIZZINESS, RESTLESSNESS, SLEEPLESSNESS, LOSS OF MEMORY, CONVULSIONS AND UNCONSCIOUSNESS.

SKIN CONTACT:

SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.

LONG TERM EFFECTS: MAY CAUSE EFFECTS AS REPORTED IN LONG TERM INHALATION. SAME EFFECTS AS SHORT TERM EXPOSURE.

EYE CONTACT:

SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.

LONG TERM EFFECTS: NO INFORMATION IS AVAILABLE.

INGESTION:

SHORT TERM EXPOSURE: NO INFORMATION AVAILABLE ON SIGNIFICANT ADVERSE EFFECTS.

LONG TERM EFFECTS: MAY CAUSE EFFECTS AS REPORTED IN LONG TERM INHALATION. ADDITIONAL EFFECTS MAY INCLUDE TWITCHING AND CONVULSIONS. MAY ALSO CAUSE REPRODUCTIVE EFFECTS.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION:
FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
FIRST AID- IF EXTENSIVE VOMITING HAS NOT OCCURRED, THE SUBSTANCE SHOULD BE REMOVED BY EMESIS OR GASTRIC LAVAGE PROVIDED THAT THE PATIENT IS CONSCIOUS AND CONVULSIONS ARE NOT PRESENT. KEEP HEAD BELOW HIPS DURING VOMITING TO PREVENT ASPIRATION. DO NOT ATTEMPT TO MAKE AN UNCONSCIOUS PERSON VOMIT. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). TREATMENT SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL.

NOTE TO PHYSICIAN
ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

DANGEROUS EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

EXTINGUISHING MEDIA:
FLOOD WITH WATER, IF NO WATER AVAILABLE USE CARBON DIOXIDE, DRY CHEMICAL OR EARTH
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
DO NOT MOVE CONTAINERS IF EXPOSURE TO HEAT HAS OCCURRED. DO NOT FIGHT FIRE WHEN IT REACHES STORAGE OR CARGO AREA. WITHDRAW FROM AREA AND LET FIRE BURN. IF POSSIBILITY EXISTS THAT CLASS A EXPLOSIVES ARE INVOLVED. EVACUATE TO A DISTANCE OF 3/4 MILE FOR TRACTOR/TRAILER LOAD; 1 MILE FOR A RAILCAR LOAD. (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5. GUIDE PAGE 46).

DANGEROUSLY EXPLOSIVE. DO NOT FIGHT FIRE IN CARGO AREA, EVACUATE AREA AND LET BURN. AVOID BREATHING DUSTS AND FUMES. EVACUATE TO A RADIUS OF 5000 FEET IF MATERIAL ON FIRE OR INVOLVED IN A FIRE.

HAZARDOUS COMBUSTION PRODUCTS:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. EVACUATE AREA FOR 2500 FEET IN ALL DIRECTIONS. KEEP UNNECESSARY PEOPLE AWAY.

SECTION 7 HANDLING AND STORAGE

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING THIS SUBSTANCE.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

STORE IN ACCORDANCE WITH 27 CFR SUBPART K AND 29 CFR 1910.109.

CONSULT NFPA PUBLICATION 495, EXPLOSIVES, STORAGE AND USE, FOR PROPER STORAGE AND HANDLING REQUIREMENTS.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
CYCLOTRIMETHYLENETRINITRAMINE:
1.5 MG/M3 OSHA TWA (SKIN)

1.5 MG/M3 ACGIH TWA (SKIN)
1.5 MG/M3 NIOSH RECOMMENDED TWA (SKIN);
3 MG/M3 NIOSH RECOMMENDED STEL

OSHA REVOKED THE FINAL RULE LIMITS OF JANUARY 19, 1989 IN RESPONSE TO THE 11TH CIRCUIT COURT OF APPEALS DECISION (AFL-CIO V. OSHA) EFFECTIVE JUNE 30, 1993. SEE 29 CFR 1910.1000 (58 FR 35338)

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET THE PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST BE BASED ON THE SPECIFIC OPERATION, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND MUST BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

ANY DUST AND MIST RESPIRATOR.

ANY AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.

ANY POWERED AIR-PURIFYING RESPIRATOR WITH A DUST AND MIST FILTER.

ANY POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.

ANY TYPE 'C' SUPPLIED-AIR RESPIRATOR OPERATED IN THE PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS-FLOW MODE.

ANY SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

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.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: WHITE, ODORLESS CRYSTALLINE POWDER.
MOLECULAR WEIGHT: 222.12
MOLECULAR FORMULA: $(C-H2-N2-O2)3$
BOILING POINT: NOT AVAILABLE
MELTING POINT: 401-403 F (205-206 C)
VAPOR PRESSURE: NEGLIGIBLE
SPECIFIC GRAVITY: 1.82
WATER SOLUBILITY: INSOLUBLE
SOLVENT SOLUBILITY: SOLUBLE IN ACETONE; SLIGHTLY SOLUBLE IN ETHER, ETHYL ACETATE, GLACIAL ACETIC ACID, METHANOL; INSOLUBLE IN ALCOHOL, CARBON DISULFIDE, AND CARBON TETRACHLORIDE.

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
CYCLOTRIMETHYLENETRINITRAMINE:
EXPOSURE TO HEAT, FRICTION, SHOCK, OR ELECTROSTATIC DISCHARGE MAY INITIATE DETONATION.

CONDITIONS TO AVOID:
DO NOT ALLOW FIRE TO REACH CARGO AREA.

INCOMPATIBILITIES:
CYCLOTRIMETHYLENETRINITRAMINE:
ACIDS: INCOMPATIBLE.
ALKALIS: INCOMPATIBLE.
GLASS: INCOMPATIBLE.
SAND: INCOMPATIBLE.
MERCURY FULMINATE: MAY EASILY INITIATE AN EXPLOSION.
METAL FRAGMENTS: INCOMPATIBLE.

HAZARDOUS DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

CYCLOTRIMETHYLENETRINITRAMINE:
TOXICITY DATA: 85 MG/KG ORAL-CHILD TDLO: 100 MG/KG ORAL-RAT LD50; 59 MG/KG ORAL-MOUSE LD50; 500 MG/KG ORAL-RABBIT LDLO; 100 MG/KG ORAL-CAT LDLO; 18 MG/KG INTRAVENOUS-RAT LDLO; 19 MG/KG INTRAVENOUS-MOUSE LD50; 25 MG/KG INTRAVENOUS-GUINEA PIG LD50; 10 MG/KG INTRAPERITONEAL-RAT LDLO; REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
ACUTE TOXICITY LEVEL: TOXIC BY INGESTION.
TARGET EFFECTS: POISONING MAY AFFECT THE CENTRAL NERVOUS SYSTEM.

HEALTH EFFECTS
INHALATION:
CYCLOTRIMETHYLENETRINITRAMINE:
ACUTE EXPOSURE- MAY CAUSE IRRITATION OF THE RESPIRATORY TRACT.
CHRONIC EXPOSURE- WORKERS EXPOSED HAVE EXPERIENCED EPILEPTIFORM CONVULSIONS OR BECAME UNCONSCIOUS WITHOUT CONVULSIONS. THE PREMONITORY SYMPTOMS INCLUDED HEADACHE, DIZZINESS, NAUSEA, AND VOMITING. WHEN CONSCIOUSNESS WAS REGAINED (WITHIN A FEW MINUTES TO 24 HOURS) INTERMITTENT STUPOR, WEAKNESS, AND NAUSEA CONTINUED. SEIZURES WERE FOLLOWED BY TEMPORARY POST-CONVULSIVE AMNESIA, MALAISE, FATIGUE, AND ASTHENIA. A FEW DAYS OF IRRITABILITY, INSOMNIA, OR RESTLESSNESS MAY ALSO PRECEDE CONVULSIONS.

SKIN CONTACT:
CYCLOTRIMETHYLENETRINITRAMINE:
ACUTE EXPOSURE- MAY CAUSE IRRITATION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE EFFECTS AS IN CHRONIC INHALATION. PRIMARY AND SENSITIZING DERMATITIS HAS BEEN REPORTED, HOWEVER LIKELY CAUSED BY IMPURITIES OR CHEMICAL INTERMEDIATES ASSOCIATED WITH ITS PRODUCTION.

EYE CONTACT:
CYCLOTRIMETHYLENETRINITRAMINE:
ACUTE EXPOSURE- MAY CAUSE IRRITATION.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

INGESTION:
CYCLOTRIMETHYLENETRINITRAMINE:
TOXIC.
ACUTE EXPOSURE- THE LETHAL DOSE REPORTED IN RATS WAS 100 MG/KG. THE SYMPTOMS WERE NOT REPORTED.
CHRONIC EXPOSURE- REPEATED INGESTION MAY CAUSE EFFECTS AS IN CHRONIC INHALATION. RATS FED DIETS CONTAINING UP TO 600 MG/KG/DAY FOR 13 WEEKS EXPERIENCED HYPOTRIGLYCERIDEMIA, HYPERREACTIVITY, TREMORS, CONVULSIONS AND DEATH. AN APPARENT DOSE RELATED INCIDENCE OF LEUKOCYTOSIS OCCURRED IN FEMALES. MULTIFOCAL DEGENERATIVE TESTICULAR LESIONS WERE SEEN IN MALES FED 300 OR 600 MG/KG/DAY. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262, EPA HAZARDOUS WASTE NUMBER D003.
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

SECTION 14 TRANSPORTATION INFORMATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
FORBIDDEN

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND SUBPART E:
NONE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.61 TO 49-CFR 173.67
EXCEPTIONS: 49-CFR 173.65

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	N
SARA SECTION 302 (40CFR355.30):	N
SARA SECTION 304 (40CFR355.40):	N
SARA SECTION 313 (40CFR372.65):	N
OSHA PROCESS SAFETY (29CFR1910.119):	N
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	N
FIRE HAZARD:	Y
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	Y

SECTION 16 OTHER

OHS24250

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000

CAS NUMBER: 99-35-4
RTECS NUMBER: DC3350000

SUBSTANCE: TRINITROBENZENE, WET

TRADE NAMES/SYNONYMS:
1,3,5-TRINITROBENZENE; TNB; BENZENITE; S-TRINITROBENZENE;
SYMMETRIC TRINITROBENZENE; RCRA U234; STCC 4917140; UN 1354;
SYM-TRINITROBENZENE; OHS24250

CHEMICAL FAMILY:
NITRO

HYDROCARBON, AROMATIC

CREATION DATE: 03/13/85 REVISION DATE: 12/26/92

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : TRINITROBENZENE, WET
CAS NUMBER: 99-35-4
PERCENTAGE: <70.0

COMPONENT : WATER
PERCENTAGE: >30.0

OTHER CONTAMINANTS: NONE

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=3 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=3 REACTIVITY=3

EMERGENCY OVERVIEW:
TRINITROBENZENE, WET IS A YELLOW SOLID IN WATER.
HARMFUL IF SWALLOWED. MAY CAUSE BLOOD DISORDERS. MAY AFFECT BLOOD CELLS.
CAUSES RESPIRATORY TRACT, SKIN AND EYE IRRITATION. MAY EXPLODE FROM HEAT.
SHOCK OR FRICTION. FLAMMABLE SOLID. MAY FORM FLAMMABLE OR EXPLOSIVE DUST-AIR
MIXTURES.
DO NOT GRIND OR SUBJECT TO HEAT OR SHOCK. KEEP AWAY FROM ALL IGNITION SOURCES.
AVOID BREATHING DUST. AVOID CONTACT WITH EYES, SKIN AND CLOTHING. AVOID

CONTAMINATION BY ANY SOURCE. KEEP CONTAINER TIGHTLY CLOSED. AVOID DISPERSION OF DUST. WASH THOROUGHLY AFTER HANDLING. USE ONLY WITH ADEQUATE VENTILATION.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE PALENESS, YELLOWING OF THE SKIN AND EYES, NAUSEA, INABILITY TO URINATE, DIFFICULTY BREATHING, LOW BLOOD PRESSURE, HEADACHE, ANEMIA, WEAKNESS, DIZZINESS, CONFUSION, CONVULSIONS AND COMA.

LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, LACK OF APPETITE MAY OCCUR.

SKIN CONTACT:

SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE PALENESS, NAUSEA, DIFFICULTY BREATHING, LOW BLOOD PRESSURE, HEADACHE, WEAKNESS, DIZZINESS, CONFUSION AND BLUISH SKIN COLOR.

LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.

EYE CONTACT:

SHORT TERM EXPOSURE: MAY CAUSE IRRITATION. ADDITIONAL EFFECTS MAY INCLUDE TEARING AND BLURRED VISION.

LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, VISUAL DISTURBANCES AND NERVE EFFECTS MAY OCCUR.

INGESTION:

SHORT TERM EXPOSURE: MAY CAUSE PALENESS, NAUSEA, DIFFICULTY BREATHING, LOW BLOOD PRESSURE, HEADACHE, WEAKNESS, DIZZINESS AND CONFUSION.

LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, YELLOWING OF THE SKIN AND EYES, LACK OF APPETITE AND ANEMIA MAY OCCUR.

CARCINOGEN STATUS:

OSHA: N

NTP: N

IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION:

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

RESPIRATOR:
HIGH LEVELS- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD. SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: LIGHT YELLOW CRYSTALLINE SLUDGE OR SLURRY
MOLECULAR WEIGHT: 213.12
MOLECULAR FORMULA: C6-H3-N3-O6
BOILING POINT: DECOMPOSES
MELTING POINT: 252 F (122 C)
VAPOR PRESSURE: 0.3846 MMHG @ 122 C
SPECIFIC GRAVITY: 1.8
WATER SOLUBILITY: 0.035%
SOLVENT SOLUBILITY: ALCOHOL, ETHER

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
HIGHLY EXPLOSIVE AND SENSITIVE TO HEAT, SHOCK OR FRICTION WHEN DRY. WET, WILL IGNITE READILY. WILL SUBLIME IF HEATED CAREFULLY.

CONDITIONS TO AVOID:
MATERIAL IS EXPLOSIVE WHEN DRY. AVOID CONTACT WITH ALL SOURCES OF IGNITION. AVOID OVERHEATING AND SHOCK.

INCOMPATIBILITIES:
TRINITROBENZENE, WET:
EXPLOSION HAZARD ON EXPOSURE TO HEAT, SHOCK OR DRYING. IGNITES READILY, EVOLVING TOXIC FUMES. MAY EXPLODE ON HEATING WITH AMMONIA. MAY FORM EXPLOSIVE COMPOUNDS ON REACTION WITH HEAVY METALS OR THEIR SALTS. MAY FORM EXPLOSIVE ACI-NITRO SALTS ON REACTION WITH ALKALIES, ESPECIALLY CONCENTRATED AQUEOUS POTASSIUM HYDROXIDE IN METHANOL. REACTS VIGOROUSLY WITH OXIDIZABLE

MATERIALS.

HAZARDOUS DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON AND NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

TRINITROBENZENE, WET:
DRY: 450 MG/KG ORAL-RAT LD50; 572 MG/KG ORAL-MOUSE LD50; 730 MG/KG ORAL-GUINEA PIG LD50; 32 MG/KG INTRAVENOUS-MOUSE LD50; MUTAGENIC DATA (RTECS):
CARCINOGEN STATUS: NONE.
TRINITROBENZENE (WET) IS AN EYE, MUCOUS MEMBRANE AND SKIN IRRITANT, METHEMOGLOBIN FORMER AND BONE MARROW DEPRESSANT. IT IS MODERATELY TO HIGHLY TOXIC ORALLY, HIGHLY TOXIC INTRAVENOUSLY. POISONING AFFECTS BLOOD, LIVER, CENTRAL NERVOUS SYSTEM AND KIDNEYS.

HEALTH EFFECTS
INHALATION:
TRINITROBENZENE, WET:
IRRITANT/METHEMOGLOBIN FORMER/BONE MARROW DEPRESSANT.
ACUTE EXPOSURE- MAY CAUSE CYANOSIS, PALLOR, NAUSEA, HEADACHE, DIZZINESS, DYSPNEA, CONFUSION, HYPOTENSION, LETHARGY. HIGHER LEVELS CAUSE CONVULSIONS, COMA AND POSSIBLY DEATH. IF DEATH IS NOT IMMEDIATE, JAUNDICE, OLIGURIA, ANURIA, APLASTIC OR HEMOLYTIC ANEMIA MAY OCCUR.
CHRONIC EXPOSURE- MAY CAUSE CYANOSIS, PALLOR, POSSIBLY PURPURA, ANOREXIA. APLASTIC OR HEMOLYTIC ANEMIA MAY DEVELOP. ONSET OF CYANOTIC SYMPTOMS IN CHRONIC VICTIMS MAY BE PRECIPITATED BY EXPOSURE TO SUNLIGHT OR INGESTION OF ETHANOL.

SKIN CONTACT:
TRINITROBENZENE, WET:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION. ABSORPTION MAY CAUSE SYSTEMIC TOXICITY WITH CYANOSIS, PALLOR, NAUSEA, HEADACHE, DIZZINESS,

DYSPNEA, CONFUSION, HYPOTENSION OR LETHARGY.
CHRONIC EXPOSURE- MAY CAUSE DERMATITIS.

EYE CONTACT:
TRINITROBENZENE, WET:
IRRITANT.
ACUTE EXPOSURE- PARTICULATES IN THE EYE MAY CAUSE IRRITATION, LACRIMATION, REDNESS, PAIN AND BLURRED VISION.
CHRONIC EXPOSURE- CHRONIC INTOXICATION MAY CAUSE YELLOWING OF CONJUNCTIVA OR SCLERA. CHRONIC EXPOSURE TO THIS CLASS OF COMPOUNDS TYPICALLY CAUSES OPTIC NEURITIS WITH BLURRING OF VISION AND AMBLYOPIA, SOMETIMES FOLLOWED BY OPTIC ATROPHY.

INGESTION:
TRINITROBENZENE, WET:
METHEMOGLOBIN FORMER/BONE MARROW DEPRESSANT/TOXIC.
ACUTE EXPOSURE- INGESTION MAY RESULT IN SYSTEMIC TOXICITY WITH CYANOSIS, PALLOR, NAUSEA, HEADACHE, DIZZINESS, DYSPNEA, CONFUSION, HYPOTENSION OR LETHARGY.
CHRONIC EXPOSURE- MAY CAUSE CYANOSIS, JAUNDICE, ANOREXIA, APLASTIC OR HEMOLYTIC ANEMIA.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

US EPA RCRA HAZARDOUS WASTE NUMBER: RCRA U234

SECTION 14 TRANSPORTATION INFORMATION

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
FLAMMABLE SOLID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND SUBPART E:
FLAMMABLE SOLID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS:

EXCEPTIONS: 49-CFR 173.212

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180). DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204. EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/90)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARDS, AND INFECTIOUS SUBSTANCES, THE EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO OCTOBER 1, 1993. (56 FR 47158, 09/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
TRINITROBENZENE-UN 1304

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
4.1 - FLAMMABLE SOLID

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG I

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
FLAMMABLE SOLID

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: NONE
NON-BULK PACKAGING: 49 CFR 173.211
BULK PACKAGING: NONE

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 0.5 KG
CARGO AIRCRAFT ONLY: 0.5 KG

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	10 POUNDS RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	N	
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65:	N	

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	Y
SUDDEN RELEASE HAZARD:	Y

SECTION 16 OTHER

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OHS12510

SECTION 1 CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

OCCUPATIONAL HEALTH SERVICES, INC.
11 WEST 42ND STREET, 12TH FLOOR
NEW YORK, NEW YORK 10036
1-800-445-MSDS (1-800-445-6737) OR
1-212-789-3535

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000

CAS NUMBER: 7439-92-1
RTECS NUMBER: OF7525000

SUBSTANCE: LEAD

TRADE NAMES/SYNONYMS:
C.I. PIGMENT METAL 4; C.I. 77575; LEAD FLAKE; KS-4; LEAD S 2; SI; SO; PLUMBUM; S0; PS-S 100; LEAD ELEMENT; L-18; L-24; L-29; L-27; T-134; 40BP, 80BP, 100BP, 200BP, FP, SFP (SCM METAL PRODUCTS INC); LEAD GRANULES; PB; OHS12510

CHEMICAL FAMILY:
METAL

CREATION DATE: 12/10/84 REVISION DATE: 03/24/93

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT : LEAD
CAS NUMBER: 7439-92-1
PERCENTAGE: 99.8

OTHER CONTAMINANTS: BISMUTH, COPPER, ARSENIC, ANTIMONY, TIN, IRON, SILVER, ZINC

SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=U FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:
LEAD IS A BLUISH-WHITE, SILVERY GRAY METAL.
SUSPECT CANCER HAZARD (CONTAINS MATERIAL WHICH CAN CAUSE CANCER IN ANIMALS). RISK OF CANCER DEPENDS ON DURATION AND LEVEL OF EXPOSURE. MAY CAUSE BIRTH DEFECTS IN HUMANS. MAY DAMAGE KIDNEYS. MAY DAMAGE NERVES. NO KNOWN FIRE OR REACTIVITY HAZARD.
AVOID BREATHING DUST. AVOID CONTACT WITH EYES, SKIN AND CLOTHING. KEEP CONTAINER TIGHTLY CLOSED. WASH THOROUGHLY AFTER HANDLING. USE ONLY WITH ADEQUATE VENTILATION.

POTENTIAL HEALTH EFFECTS:

INHALATION:
SHORT TERM EXPOSURE: MAY CAUSE KIDNEY DAMAGE, NERVE DAMAGE, COUGHING, SWEATING, METALLIC TASTE, THIRST, CHILLS, FEVER, YELLOWING OF THE SKIN AND EYES, DROOLING, VOMITING, DIGESTIVE DISORDERS, BLOOD IN THE URINE, BLOOD IN THE STOOL, FREQUENT URINATION, HEADACHE, WEAKNESS, DISORIENTATION, RESTLESSNESS, SLEEPLESSNESS, TINGLING SENSATION, MUSCLE PAIN, LOSS OF MEMORY, PARALYSIS, EFFECTS ON THE BRAIN, CONVULSIONS AND SHOCK. MAY ALSO CAUSE REPRODUCTIVE EFFECTS.
LONG TERM EFFECTS: IN ADDITION TO EFFECTS FROM SHORT TERM EXPOSURE, BLACK LINES ON THE GUMS, LACK OF APPETITE, WEIGHT LOSS, HIGH BLOOD PRESSURE, ANEMIA, INCOORDINATION, NERVOUSNESS, TWITCHING, VISUAL DISTURBANCES, IMPOTENCE, STERILITY, UNCONSCIOUSNESS AND COMA MAY OCCUR. MAY ALSO CAUSE REPRODUCTIVE EFFECTS.

SKIN CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.
LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.

EYE CONTACT:
SHORT TERM EXPOSURE: MAY CAUSE IRRITATION.
LONG TERM EFFECTS: SAME EFFECTS AS SHORT TERM EXPOSURE.

INGESTION:
SHORT TERM EXPOSURE: MAY CAUSE EFFECTS AS REPORTED IN SHORT TERM INHALATION. ADDITIONAL EFFECTS MAY INCLUDE KIDNEY DAMAGE AND NERVE DAMAGE. MAY ALSO CAUSE REPRODUCTIVE EFFECTS.
LONG TERM EFFECTS: NO INFORMATION AVAILABLE ON SIGNIFICANT ADVERSE EFFECTS

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: Y

SECTION 4 FIRST AID MEASURES

INHALATION:
FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS. UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
FIRST AID- DO NOT INDUCE VOMITING. QUALIFIED MEDICAL PERSONNEL SHOULD REMOVE CHEMICAL BY GASTRIC LAVAGE OR CATHARSIS. ACTIVATED CHARCOAL IS USEFUL. GET MEDICAL ATTENTION IMMEDIATELY.

NOTE TO PHYSICIAN
ANTIDOTE:
THE FOLLOWING ANTIDOTE HAS BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

FOR LEAD POISONING:
INITIATE URINE FLOW FIRST. GIVE 10% DEXTROSE IN WATER INTRAVENOUSLY, 10-20 ML/KG BODY WEIGHT, OVER A PERIOD OF 1-2 HOURS. IF URINE FLOW DOES NOT START, GIVE MANNITOL, 20% SOLUTION, 5-10 ML/KG BODY WEIGHT INTRAVENOUSLY OVER 30 MINUTES. FLUID MUST BE LIMITED TO REQUIREMENTS AND CATHERTIZATION MAY BE NECESSARY IN COMA. DAILY URINE OUTPUT SHOULD BE 350-500 ML/M2/24 HOURS. EXCESSIVE FLUIDS FURTHER INCREASE CEREBRAL EDEMA.
FOR ADULTS WITH ACUTE ENCEPHALOPATHY, GIVE DIMERCAPROL, 4 MG/KG, INTRAMUSCULARLY EVERY 4 HOURS FOR 30 DOSES. BEGINNING 4 HOURS LATER, GIVE CALCIUM DISODIUM EDETATE AT A SEPERATE INJECTION SITE, 12.5 MG/KG INTRAMUSCULARLY EVERY 4 HOURS AS A 20% SOLUTION, WITH 0.5% PROCAINE ADDED, FOR A TOTAL OF 30 DOSES. IF SIGNIFICANT IMPROVEMENT HAS NOT OCCURRED BY THE FOURTH DAY, INCREASE THE NUMBER OF INJECTIONS BY 10 FOR EACH DRUG.
FOR SYMPTOMATIC ADULTS, THE COURSE OF DIMERCAPROL AND CALCIUM DISODIUM EDETATE CAN BE SHORTENED OR CALCIUM DISODIUM EDETATE ONLY CAN BE GIVEN IN A DOSAGE OF 50 MG/KG INTRAVENOUSLY AS 0.5% SOLUTION IN 5% DEXTROSE IN WATER OR NORMAL SALINE BY INFUSION OVER NOT LESS THAN 8 HOURS FOR NOT MORE THAN 5 DAYS. FOLLOW WITH PENICILLAMINE, 500-750 MG/DAY, ORALLY FOR 1-2 MONTHS OR UNTIL URINE LEAD LEVELS DROPS BELOW 0.3 MG/24 HOURS (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD IN BULK FORM; HOWEVER, DUST, POWDER, OR FUMES ARE FLAMMABLE OR EXPLOSIVE WHEN EXPOSED TO HEAT OR FLAMES.

EXTINGUISHING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR REGULAR FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR REGULAR FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 53).

EXTINGUISH USING AGENT SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING VAPORS AND DUSTS. KEEP UPWIND.

HAZARDOUS COMBUSTION PRODUCTS:
THERMAL DECOMPOSITION PRODUCTS ARE TOXIC OXIDES OF LEAD.

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

RESIDUE SHOULD BE CLEANED UP USING A HIGH-EFFICIENCY PARTICULATE FILTER VACUUM.

REPORTABLE QUANTITY (RQ): 1 POUND
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

WATER SPILL:
THE CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (PROPOSITION 65) PROHIBITS CONTAMINATING ANY KNOWN SOURCE OF DRINKING WATER WITH SUBSTANCES KNOWN TO CAUSE CANCER AND/OR REPRODUCTIVE TOXICITY.

SECTION 7 HANDLING AND STORAGE

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING THIS SUBSTANCE.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
LEAD, INORGANIC FUMES AND DUST (AS PB):
50 UG/M3 OSHA 8 HOUR TWA
30 UG/M3 OSHA 8 HOUR TWA ACTION LEVEL
IF AN EMPLOYEE IS EXPOSED TO LEAD FOR MORE THAN 8 HOURS PER DAY THE FOLLOWING FORMULA IS USED:
MAXIMUM PERMISSIBLE LIMIT (IN UG/M3)= 400 DIVIDED BY HOURS WORKED IN THE DA
0.15 MG/M3 ACGIH TWA
<0.10 MG/M3 NIOSH RECOMMENDED 10 HOUR TWA
0.1 MG/M3 DFG MAK TWA;
1.0 MG/M3 DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 1 TIME/SHIFT

MEASUREMENT METHOD: PARTICULATE FILTER; NITRIC ACID/HYDROGEN PEROXIDE; ATOMIC ABSORPTION SPECTROMETRY; (NIOSH VOL. III # 7082).

1 POUND CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY WARNING AND RELEASE REQUIRMENTS- (FEBRUARY 27, 1987)

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
VENTILATION SHOULD MEET THE REQUIREMENTS IN 29 CFR 1910.1025(E).

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
PROTECTIVE EYE EQUIPMENT SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29 CFR 1910.1025(G).

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

LEAD (ELEMENTAL, INORGANIC, AND SOAPS):
PROTECTIVE CLOTHING SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29 CFR 1910.1025(G).

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

LEAD (ELEMENTAL, INORGANIC & SOAPS):
PROTECTIVE GLOVES SHOULD MEET THE REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT IN 29 CFR 1910.1025(G).

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE THE MINIMUM LEGAL REQUIREMENTS AS SET FORTH BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION FOUND IN 29 CFR 1910, SUBPART Z.

RESPIRATORY PROTECTION FOR LEAD AEROSOLS

AIRBORNE CONCENTRATION OF LEAD OR CONDITION OF USE	REQUIRED RESPIRATOR
NOT IN EXCESS OF 0.5 MG/M3 (10X PEL)	HALF-MASK, AIR PURIFYING RESPIRATOR EQUIPPED WITH HIGH-EFFICIENCY FILTERS.
NOT IN EXCESS OF 2.5 MG/M3 (50X PEL)	FULL FACEPIECE, AIR-PURIFYING RESPIRATOR WITH HIGH EFFICIENCY FILTERS.

NOT IN EXCESS OF 50 MG/M3 (10X PEL)	ANY POWERED AIR-PURIFYING RESPIRATOR WITH HIGH EFFICIENCY FILTERS; OR HALF-MASK SUPPLIED-AIR RESPIRATOR OPERATED IN POSITIVE-PRESSURE MODE.
NOT IN EXCESS OF 100 MG/M3	SUPPLIED-AIR RESPIRATORS WITH FULL FACEPIECE, HOOD OR HELMET OR SUIT, OPERATED IN POSITIVE PRESSURE MODE.
GREATER THAN 100 MG/M3, UNKNOWN CONCENTRATIONS OR FIREFIGHTING	FULL FACEPIECE, SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE-PRESSURE MODE.

(RESPIRATORS SPECIFIED FOR HIGHER CONCENTRATIONS CAN BE USED AT LOWER CONCENTRATIONS OF LEAD).
(FULL FACEPIECE IS REQUIRED IF THE LEAD AEROSOLS CAUSE EYE OR SKIN IRRITATION AT THE USE CONCENTRATIONS.)
(A HIGH EFFICIENCY PARTICULATE FILTER MEANS 99.97% EFFICIENT AGAINST 0.3 MICRON PARTICLES.)

THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

LEAD, INORGANIC FUMES AND DUSTS (AS PB):

0.50 MG(PB)/M3- ANY SUPPLIED-AIR RESPIRATOR.
ANY AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SELF-CONTAINED BREATHING APPARATUS.

1.25 MG(PB)/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

2.50 MG(PB)/M3- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A TIGHT-FITTING FACEPIECE OPERATED IN A CONTINUOUS FLOW MODE.

50.0 MG(PB)/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A PRESSURE-DEMAND

OR OTHER POSITIVE PRESSURE MODE.

100.0 MG(PB)/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

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.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: BLUISH-WHITE, SILVERY GRAY, HEAVY, MALLEABLE METAL
MOLECULAR WEIGHT: 207.19
MOLECULAR FORMULA: PB
BOILING POINT: 3164 F (1740 C)
MELTING POINT: 622 F (328 C)
VAPOR PRESSURE: 1.3 MMHG @ 970 C
SPECIFIC GRAVITY: 11.3
WATER SOLUBILITY: INSOLUBLE
SOLVENT SOLUBILITY: SOLUBLE IN NITRIC ACID, HOT CONCENTRATED SULFURIC ACID

HARDNESS: 1.5 MOHS

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

CONDITIONS TO AVOID:
MAY BURN BUT DOES NOT IGNITE READILY. PREVENT DISPERSION OF DUST IN AIR. DO NOT ALLOW SPILLED MATERIAL TO CONTAMINATE WATER SOURCES.

INCOMPATIBILITIES:
LEAD:
AMMONIUM NITRATE: VIOLENT OR EXPLOSIVE REACTION.
CHLORINE TRIFLUORIDE: VIOLENT REACTION.
DISODIUM ACETYLIDE: TRITURATION IN MORTAR MAY BE VIOLENT AND LIBERATE CARBON.
HYDROGEN PEROXIDE (52% OR GREATER): VIOLENT DECOMPOSITION.
HYDROGEN PEROXIDE (60% SOLUTION) AND TRIOXANE: SPONTANEOUSLY DETONABLE.

METALS (ACTIVE): INCOMPATIBLE.
NITRIC ACID: LEAD-CONTAINING RUBBER MAY IGNITE.
OXIDIZERS (STRONG): INCOMPATIBLE.
SODIUM AZIDE: FORMS LEAD AZIDE AND COPPER AZIDE IN COPPER PIPE.
SODIUM CARBIDE: VIGOROUS REACTION.
SULFURIC ACID (HOT): REACTS.
ZIRCONIUM-LEAD ALLOYS: IGNITION ON IMPACT.

HAZARDOUS DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS ARE TOXIC OXIDES OF LEAD.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

SECTION 11 TOXICOLOGY INFORMATION

LEAD:
TOXICITY DATA: 10 UG/M3 INHALATION-HUMAN TCLO; 450 MG/KG/6 YEARS ORAL-WOMAN TDLO; 1000 MG/KG INTRAPERITONEAL-RAT LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: HUMAN INADEQUATE EVIDENCE. ANIMAL SUFFICIENT EVIDENCE (IARC GROUP-2B FOR INORGANIC LEAD COMPOUNDS). RENAL TUMORS WERE PRODUCED IN ANIMALS BY LEAD ACETATE, SUBACETATE AND PHOSPHATE GIVEN ORALLY, SUBCUTANEOUSLY OR INTRAPERITONEALLY. NO EVALUATION COULD BE MADE OF THE CARCINOGENICITY OF POWDERED LEAD.
ACUTE TOXICITY LEVEL: INSUFFICIENT DATA.
TARGET EFFECTS: NEUROTOXIN; NEPHROTOXIN; TERATOGEN. POISONING MAY ALSO AFFECT THE BLOOD, HEART, AND THE ENDOCRINE AND IMMUNE SYSTEMS.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH NERVOUS SYSTEM OR GASTROINTESTINAL DISORDERS, ANEMIA, OR CHRONIC BRONCHITIS.
ADDITIONAL DATA: MAY CROSS THE PLACENTA. SMOKING MAY RESULT IN HIGH BLOOD LEAD LEVELS.

HEALTH EFFECTS
INHALATION:
LEAD:
SEE INFORMATION ON LEAD COMPOUNDS AND METAL FUME FEVER.

LEAD COMPOUNDS:
NEUROTOXIN/NEPHROTOXIN/TERATOGEN.
ACUTE EXPOSURE- ABSORPTION OF LARGE AMOUNTS OF LEAD MAY CAUSE A METALLIC TASTE, THIRST, A BURNING SENSATION IN THE MOUTH AND THROAT, SALIVATION, ABDOMINAL PAIN WITH SEVERE COLIC, VOMITING, DIARRHEA OF BLACK OR BLOODY STOOLS, CONSTIPATION, FATIGUE, SLEEP DISTURBANCES, DULLNESS, RESTLESSNESS, IRRITABILITY, MEMORY LOSS, LOSS OF CONCENTRATION, DELIRIUM, OLIGURIA OFTEN WITH HEMATURIA AND ALBUMINURIA, ENCEPHALOPATHY WITH VISUAL FAILURE, PARESTHESIAS, MUSCLE PAIN AND WEAKNESS, CONVULSIONS, AND PARALYSIS. DEATH MAY RESULT FROM CARDIORESPIRATORY ARREST OR SHOCK. SURVIVORS OF ACUTE EXPOSURE MAY EXPERIENCE THE ONSET OF CHRONIC INTOXICATION. LIVER EFFECTS MAY INCLUDE ENLARGEMENT AND TENDERNESS, AND JAUNDICE. THE FATAL DOSE OF ABSORBED LEAD IS APPROXIMATELY 0.5 GRAMS. PATHOLOGICAL FINDINGS INCLUDE GASTROINTESTINAL INFLAMMATION AND RENAL TUBULAR DEGENERATION.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO LOW LEVELS OF LEAD MAY RESULT IN AN ACCUMULATION IN BODY TISSUES AND EXERT ADVERSE EFFECTS ON THE BLOOD, NERVOUS SYSTEMS, HEART, ENDOCRINE AND IMMUNE SYSTEMS, KIDNEYS AND REPRODUCTION. EARLY STAGES OF LEAD POISONING, "PLUMBISM", MAY BE EVIDENCED BY ANOREXIA, WEIGHT LOSS, CONSTIPATION, APATHY OR IRRITABILITY, OCCASIONAL VOMITING, FATIGUE, HEADACHE, WEAKNESS, METALLIC TASTE IN THE MOUTH, GINGIVAL LEAD LINE IN PERSONS WITH POOR DENTAL HYGIENE, AND ANEMIA. LOSS OF RECENTLY DEVELOPED MOTOR SKILLS IS GENERALLY OBSERVED ONLY IN CHILDREN. MORE ADVANCED STAGES OF POISONING MAY BE CHARACTERIZED BY INTERMITTENT VOMITING, IRRITABILITY AND NERVOUSNESS, MYALGIA OF THE ARMS, LEGS, JOINTS AND ABDOMEN, PARALYSIS OF THE EXTENSOR MUSCLES OF THE ARMS AND LEGS WITH WRIST AND/OR FOOT DROP. SEVERE "PLUMBISM" MAY RESULT IN PERSISTENT VOMITING, ATAXIA, PERIODS OF STUPOR OR LETHARGY, ENCEPHALOPATHY WITH VISUAL DISTURBANCES WHICH MAY PROGRESS TO OPTIC NEURITIS AND ATROPHY, HYPERTENSION, PAPILLEDEMA, CRANIAL NERVE PARALYSIS, DELIRIUM, CONVULSIONS, AND COMA. NEUROLOGIC SEQUELAE MAY INCLUDE MENTAL RETARDATION, SEIZURES, CEREBRAL PALSY, AND DYSTONIA MUSCULORUM DEFORMANS. IRREVERSIBLE KIDNEY DAMAGE HAS BEEN ASSOCIATED WITH INDUSTRIAL EXPOSURE. REPRODUCTIVE EFFECTS HAVE BEEN EXHIBITED IN BOTH MALES AND FEMALES. PATERNAL EFFECTS MAY INCLUDE DECREASED SEX DRIVE, IMPOTENCE, STERILITY AND ADVERSE EFFECTS ON THE SPERM WHICH MAY INCREASE THE RISK OF BIRTH DEFECTS. MATERNAL EFFECTS MAY INCLUDE MISCARRIAGE AND STILLBIRTHS IN EXPOSED WOMEN OR WOMEN WHOSE HUSBANDS WERE EXPOSED, ABORTION, STERILITY OR DECREASED FERTILITY, AND ABNORMAL MENSTRUAL CYCLES. LEAD CROSSES THE PLACENTA AND MAY AFFECT THE FETUS CAUSING BIRTH DEFECTS, MENTAL RETARDATION, BEHAVIORAL DISORDERS, AND DEATH DURING THE FIRST YEAR OF CHILDHOOD. ANIMAL STUDIES INDICATE THAT REPRODUCTIVE EFFECTS MAY BE ADDITIVE IF BOTH PARENTS ARE EXPOSED TO LEAD.

METAL FUME FEVER:

ACUTE EXPOSURE- METAL FUME FEVER, AN INFLUENZA-LIKE ILLNESS, MAY OCCUR DUE TO THE INHALATION OF FRESHLY FORMED METAL OXIDE PARTICLES SIZED BELOW 1.5 MICRONS AND USUALLY BETWEEN 0.02-0.05 MICRONS. SYMPTOMS MAY BE DELAYED 4-12 HOURS AND BEGIN WITH A SUDDEN ONSET OF THIRST, AND A SWEET METALLIC OR FOUL TASTE IN THE MOUTH. OTHER SYMPTOMS MAY INCLUDE UPPER RESPIRATORY TRACT IRRITATION ACCOMPANIED BY COUGHING AND A DRYNESS OF THE MUCOUS MEMBRANES. LASSITUDE AND A GENERALIZED FEELING OF MALAISE. FEVER, CHILLS, MUSCULAR PAIN, MILD TO SEVERE HEADACHE, NAUSEA, OCCASIONAL VOMITING, EXAGGERATED MENTAL ACTIVITY, PROFUSE SWEATING, EXCESSIVE URINATION, DIARRHEA AND PROSTRATION MAY ALSO OCCUR. TOLERANCE TO FUMES DEVELOPS RAPIDLY, BUT IS QUICKLY LOST. ALL SYMPTOMS USUALLY SUBSIDE WITHIN 24-36 HOURS.

CHRONIC EXPOSURE- THERE IS NO FORM OF CHRONIC METAL FUME FEVER. HOWEVER, REPEATED BOUTS WITH SYMPTOMS AS DESCRIBED ABOVE ARE QUITE COMMON. RESISTANCE TO THE CONDITION DEVELOPS AFTER A FEW DAYS OF EXPOSURE, BUT IS QUICKLY LOST IN 1 OR 2 DAYS.

SKIN CONTACT:

LEAD:

SEE INFORMATION ON LEAD COMPOUNDS.

LEAD COMPOUNDS:

ACUTE EXPOSURE- CONTACT WITH LEAD POWDERS OR DUST MAY BE IRRITATING. LEAD IS NOT ABSORBED THROUGH THE SKIN, BUT MAY BE TRANSFERRED TO THE MOUTH INADVERTENTLY BY CIGARETTES, CHEWING TOBACCO, FOOD, OR MAKE-UP.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO THE POWDER OR DUST MAY RESULT IN DERMATITIS. SYSTEMIC TOXICITY MAY DEVELOP IF LEAD IS TRANSFERRED TO THE MOUTH BY CIGARETTES, CHEWING TOBACCO, FOOD, OR MAKE-UP.

EYE CONTACT:
LEAD:
SEE INFORMATION ON LEAD COMPOUNDS.

LEAD COMPOUNDS:
ACUTE EXPOSURE- LEAD DUST OR POWDERS MAY BE IRRITATING. METALLIC LEAD PARTICLES MAY CAUSE AN INFLAMMATORY FOREIGN BODY REACTION AND INJURY IS GENERALLY THOUGHT TO BE MECHANICAL AND NOT TOXIC.
CHRONIC EXPOSURE- PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

INGESTION:
LEAD:
SEE INFORMATION ON LEAD COMPOUNDS.

LEAD COMPOUNDS:
NEUROTOXIN/NEPHROTOXIN/TERATOGEN.
ACUTE EXPOSURE- ABSORPTION OF LARGE AMOUNTS OF LEAD FROM THE INTESTINAL TRACT MAY CAUSE ALL THE SAME EFFECTS AS DETAILED IN ACUTE INHALATION. THE FATAL DOSE OF ABSORBED LEAD IS APPROXIMATELY 0.5 GRAMS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO LOW LEVELS OF LEAD MAY RESULT IN AN ACCUMULATION IN BODY TISSUES AND ADVERSE EFFECTS ON THE KIDNEYS, HEART AND BLOOD AND ON THE NERVOUS, REPRODUCTIVE, ENDOCRINE AND IMMUNE SYSTEMS AS DETAILED IN CHRONIC INHALATION.

SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): NO DATA AVAILABLE

ACUTE AQUATIC TOXICITY: NO DATA AVAILABLE

DEGRADABILITY: NO DATA AVAILABLE

LOG BIOCONCENTRATION FACTOR (BCF): NO DATA AVAILABLE

LOG OCTANOL/WATER PARTITION COEFFICIENT: NO DATA AVAILABLE

SECTION 13 DISPOSAL INFORMATION

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN DISPOSING OF THIS SUBSTANCE.

LEAD - REGULATORY LEVEL: 5.0 MG/L (TCLP-40 CFR 261 APPENDIX II)
MATERIALS WHICH CONTAIN THE ABOVE SUBSTANCE AT OR ABOVE THE TCLP REGULATORY LEVEL MEET THE EPA TOXICITY CHARACTERISTIC, AND MUST BE DISPOSED OF IN ACCORDANCE WITH 40 CFR PART 262. EPA HAZARDOUS WASTE NUMBER D008.

SECTION 14 TRANSPORTATION INFORMATION

NO CLASSIFICATION CURRENTLY ASSIGNED

SECTION 15 REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40CFR302.4):	Y	1 POUND RQ
SARA SECTION 302 (40CFR355.30):	N	
SARA SECTION 304 (40CFR355.40):	N	
SARA SECTION 313 (40CFR372.65):	Y	
OSHA PROCESS SAFETY (29CFR1910.119):	N	
CALIFORNIA PROPOSITION 65.	Y	

SARA HAZARD CATEGORIES. SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	N
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16 OTHER

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ISOBUTYLENE

IBL

Common Synonyms
Isobutene
2-Methylpropene

Liquefied compressed gas | Colorless | Sweet gasoline-like odor

Floats and boils on water. Flammable visible vapor cloud is produced.

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

Stop flow of gas if possible.
Cool exposed containers and protect men effecting shutoff with water.
Let fire burn.
Extinguish small fires with water, dry chemical, or carbon dioxide.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause dizziness, or loss of consciousness.

Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will cause frostbite.

Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.

Water Pollution

Not harmful to aquatic life.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Restrict access
Evacuate area

2. LABEL

2.1 **Category:** Flammable gas
2.2 **Class:** 2

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Olefin
3.2 **Formula:** $(CH_3)_2C = CH_2$
3.3 **IMO/UN Designation:** 2./1055
3.4 **DOT ID No.:** 1055
3.5 **CAS Registry No.:** 115-11-7

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid under pressure
4.2 **Color:** Colorless
4.3 **Odor:** Mild sweetish

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Chemical gloves and eye protection; organic vapor canister or self-contained breathing apparatus.
5.2 **Symptoms Following Exposure:** Inhalation of moderate concentrations causes dizziness, drowsiness, and unconsciousness. Contact with eyes or skin may cause irritation; the liquid may cause frostbite.
5.3 **Treatment of Exposure:** INHALATION: remove victim to fresh air and apply resuscitation; call a physician promptly if victim is unconscious. EYES: if irritated, wash with water. SKIN: if irritated, wash with soap and water.
5.4 **Threshold Limit Value:** 1000 ppm (8 hr)
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Not pertinent
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors are non-irritating to eyes and throat.
5.9 **Liquid or Solid Irritant Characteristics:** No appreciable hazard. Practically harmless to skin because it is very volatile and evaporate quickly. May cause frostbite.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

6. FIRE HAZARDS

6.1 **Flash Point:** Gas
6.2 **Flammable Limits in Air:** 1.8%-9.6%
6.3 **Fire Extinguishing Agents:** Let fire burn, stop flow of gas. Water fog, dry chemical, or carbon dioxide may be used for small fires.
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Containers may explode in fire. Vapor is heavier than air and may travel a long distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 869°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Data not available
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 30

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** None
8.2 **Waterfowl Toxicity:** None
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Commercial
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Safety relief

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-B-C-D-E-F-G

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable gas
11.2 **NAS Hazard Rating for Bulk Water Transportation:** Not listed
11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	4
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Gas
12.2 **Molecular Weight:** 56.10
12.3 **Boiling Point at 1 atm:** 19.6°F = —6.9°C = 266.3°K
12.4 **Freezing Point:** —220°F = —140.3°C = 132.9°K
12.5 **Critical Temperature:** 292.5°F = —144.7°C = 417.9°K
12.6 **Critical Pressure:** 580 psia = 39.48 atm = 3.99 MN/m²
12.7 **Specific Gravity:** 0.59 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 15.8 dynes/cm = 0.0158 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** (est.) 40 dynes/cm = 0.04 N/m at —10°C
12.10 **Vapor (Gas) Specific Gravity:** 1.9
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.061
12.12 **Latent Heat of Vaporization:** 170 Btu/lb = 94.3 cal/g = 3.95×10^5 J/kg
12.13 **Heat of Combustion:** —19,359 Btu/lb = —10,755 cal/g = -450.29×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 25.25 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** 14.68 (Est.)
6.12 **Flame Temperature:** Data not available

ISOBUTYLENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT	—20	.498	—115	1.175	—20	.195
		—15	.501	—110	1.160	—10	.190
		—10	.504	—105	1.145	0	.184
		—5	.507	—100	1.130	10	.179
		0	.510	—95	1.115		
		5	.513	—90	1.100		
		10	.516	—85	1.085		
		15	.520	—80	1.070		
				—75	1.054		
				—70	1.039		
				—65	1.024		
				—60	1.009		
				—55	.994		
				—50	.979		
				—45	.964		
				—40	.949		
				—35	.934		
				—30	.919		
				—25	.904		
				—20	.889		
				—15	.874		
				—10	.859		
				—5	.844		
				0	.829		
				5	.814		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOLUBLE	—55	2.182	—55	.02818	0	.597
		—50	2.534	—50	.03233	25	.606
		—45	2.933	—45	.03696	50	.614
		—40	3.382	—40	.04212	75	.623
		—35	3.887	—35	.04783	100	.632
		—30	4.453	—30	.05416	125	.640
		—25	5.085	—25	.06114	150	.649
		—20	5.789	—20	.06882	175	.657
		—15	6.572	—15	.07724	200	.665
		—10	7.440	—10	.08647	225	.673
		—5	8.400	—5	.09655	250	.681
		0	9.458	0	.10750	275	.689
		5	10.620	5	.11950	300	.697
		10	11.900	10	.13240	325	.705
		15	13.300	15	.14640	350	.713
		20	14.830	20	.16160	375	.720
		25	16.500	25	.17790	400	.728
		30	18.320	30	.19550	425	.735
		35	20.290	35	.21440	450	.743
		40	22.430	40	.23460	475	.750
		45	24.750	45	.25630	500	.757
		50	27.260	50	.27950	525	.764
		55	29.960	55	.30420	550	.771
		60	32.870	60	.33060	575	.778
		65	36.000	65	.35860	600	.785
		70	39.360	70	.38840		

LYME DISEASE INFORMATION SHEET

PUBLIC HEALTH FACT SHEET

LYME DISEASE IN MAINE

Acknowledgements: Portions of this text are reproduced from Fact Sheets published by the Massachusetts and Maryland Departments of Public Health.

What is Lyme Disease?

Lyme Disease is an illness caused by bacteria that are transmitted to humans, dogs, horses and other animals by the bite of an infected deer tick (Ixodes dammini). While rarely life-threatening it is an important illness because of its potential to cause problems in the joints, nervous system, and heart.

Where is Lyme Disease Found?

Transmission of Lyme Disease has been documented in many parts of the world. It occurs over wide areas of the United States, but particularly along the east coast. It was first recognized in the U.S. in 1975 as the result of an investigation of a group of children with arthritis in Lyme, Connecticut.

Cases of Lyme Disease have occurred in Southern Maine. Deer ticks have been identified in coastal York and Cumberland counties and in a few other scattered areas, particularly along the coast. Investigations are continuing to determine the distribution of the tick and the extent of Lyme Disease transmission in Maine.

How is Lyme Disease Transmitted?

The bacteria that cause Lyme Disease are acquired by juvenile deer ticks (larvae) through feeding on an infected animal, usually a mouse. At a subsequent stage in development (nymph), the ticks cling to vegetation in brushy, wooded, or grassy areas and transfer by direct contact to the skin of passing animals and humans. The bite of the infected tick can then transmit the bacteria to the new host. This transmission of the infectous organism appears to require that the tick be attached for at least 24 hours.

The immature deer tick is very small, and when attached to the skin may not be immediately noticeable. The approximate size of the tick at various stages of development is illustrated below:

	Larva	Nymph	Adult		Engorged adult
Actual size	*			⇨	
	August September	June July	April, May September - December		

During its complex two-year life cycle the tick can infect a variety of hosts including white-footed mice, deer, and other wild and domestic animals as well as humans. Lyme Disease is most commonly acquired in the summer months, less often in early spring or late fall, and only rarely during the winter.

It is important to note that not all ticks carry Lyme disease. The common dog tick for example does not transmit the infection. Even a deer tick bite does not necessarily mean that disease will follow, because not all members of the species are infected. Prompt removal of a tick will greatly decrease the risk of disease transmission.

What are the symptoms of Lyme Disease?

Early Symptoms:

The first symptom of Lyme Disease is usually-but not always- a skin rash called Erythema Migrans (EM). While the tick may have gone undetected, the rash occurs at the site of the bite. It begins as a small red area 3 to 32 days after the bite, then gradually enlarges, often with partial clearing at the center, so that it resembles a doughnut. The rash may be accompanied by flu-like sumptoms such as fever, headache, stiff neck, sore and aching muscles and joints, fatigue, sore throat, and swollen glands. There may be multiple rashes in other areas of the body that develop after the rash that occurs at the site of the bite. These symptoms may disappear on their own over a period of weeks. However, the rash may recur in about 50% of untreated people and more serious problems may develop later. Treatment with appropriate antibiotics clears up the rash within days and may prevent complications.

Late Symptoms:

Three major organ systems-the joints, nervous system, and heart-can be affected weeks-months after the initial tick bite, although symptoms usually appear within four to six weeks. A small

number of people with Lyme Disease may develop symptoms during later stages without having had the early skin rash.

Arthritis in the large joints (primarily the knee, elbow, and wrist) occurs in more than one-half of untreated persons. The arthritis may move from joint to joint and can become chronic.

Nervous system complications occur in 10% - 20% of infected persons. These complications may take many forms, some quite serious. Treatment with intravenous antibiotics can be helpful.

Heart symptoms occur in 6% - 10% of infected persons. Electrical conduction in the heart may be affected and the heart muscle may become inflamed.

How is Lyme Disease Diagnosed?

Diagnosis is based primarily on recognition of the typical symptoms of Lyme Disease, especially the characteristic early rash and on the history of possible tick exposure, such as outdoor activity in a high-risk area. Atypical cases or cases with only later stage complications can be difficult to diagnose. Laboratory tests are helpful in some circumstances, but require very careful interpretation by a physician. In general, the lab tests are more useful in aiding the diagnosis of disease in later stages than in diagnosing early Lyme Disease.

What is the Treatment for Lyme Disease?

Oral antibiotic treatment is beneficial early in illness. Two commonly used medications in this settings are Tetracycline and Amoxicillin, although other antibiotics may be substituted. Prompt treatment of early Lyme Disease may prevent later and more serious complications. Treatment of joint and nervous system complications is often accomplished with antibiotics given intravenously or by injection.

How Can Lyme Disease be Prevented?

The only known way to get Lyme Disease is from the bite of an infected tick. Knowing where these ticks are found, avoiding such areas, and promptly removing the tick are the primary preventive measures. Persons living in or visiting high-risk areas should take the following precautions:

- Don't walk barelegged in woods, brush, or tall grass where ticks may be found.
- If you do walk in such areas, wear a long-sleeved shirt, long pants, high socks (with pants tucked into socks), and closed shoes or boots. Light colors will help you spot ticks on clothing.
- Apply a commercial tick repellant on clothing, shoes, and socks after reading label instructions carefully. Avoid applying high concentration products to the skin, particularly of children.
- Conduct daily "tick checks" on yourself, your children, companions and on pets when you get in from the field. Shower, if possible. The ticks are often found on the thigh, flank, arms, underarms, and legs, and may be very small. Prompt removal of the tick will prevent infection.
- To remove an embedded tick, use tweezers to grip its body as close to the skin as possible and pull gently but firmly until the tick lets go. If tweezers are unavailable, grasp the tick with piece of tissue. Do not handle the tick with bare hands.
- Know the symptoms of Lyme Disease. If you have been in an area where ticks are found, and you develop such symptoms, particularly the skin rash and/or "flu" symptoms, see a physician promptly for evaluation and treatment.

The Maine Lyme Disease Task Force is involved in efforts to determine the extent of Lyme Disease incidence and the distribution of deer ticks in Maine. Members of the group include community physicians, and representatives of the State government (Departments of Human Services, Conservation, Agriculture, Inland Fisheries and Wildlife) and of the Maine Medical Center Department of Research.

If you find ticks you would like to have identified, submit them to:

Insect and Disease Laboratory
Maine Forestry Service
50 Hospital Street
Augusta, ME 04330

OR

Maine Lyme Disease Project
Maine Medical Center
22 Bramhall Street
Portland, ME 04102

Place the whole tick in rubbing alcohol in a tightly sealed container, pack carefully to prevent breakage, and mail in a crush-proof container. Please enclose your name, address, and phone number, note the geographic location and the date on which the tick was found, and information as to whether the tick was found on a human or an animal.

PRODUCED BY THE MAINE LYME DISEASE TASK FORCE
Distributed By the Maine Department of Human Services, Bureau of Health
157 Capitol Street, Augusta, Me 04333 (207) 289-3591

5/90

PROTECTING YOURSELF FROM LYME DISEASE IN MAINE - 1990

Lyme disease is an illness caused by a corkscrew-shaped bacteria called a spirochete that is transmitted to people, dogs, horses and other animals by tick bites. If not treated, Lyme disease may lead to arthritis, neurological or cardiac problems, and possibly birth defects.

In Maine, although only a few cases of Lyme disease have been reported officially, the tick that spreads Lyme disease is fairly common in coastal York and Cumberland Counties. It is occasionally found in other scattered areas, particularly along the coast.

The tick that transmits Lyme disease in Maine is the deer tick, Ixodes dammini. The life cycle has three stages, each of which takes one blood meal.

	Larva	Nymph	Adult	Engorged adult
Actual size	*			
	August September	June July	April, May September-December	

June and July are peak months for Lyme disease when the inconspicuous nymphs are active. Adults can also transmit the Lyme disease spirochetes but larvae are rarely infected.

Not all deer ticks contain the spirochete. Although some infected ticks are found in Maine, the numbers vary with locality and are generally lower than in states to the south where Lyme disease is more established.

Other varieties of Maine ticks, some of which look very much like deer ticks, may bite people and domestic animals but are not thought to transmit Lyme disease effectively.

Ixodes cookei, the "woodchuck tick", which cannot reliably be distinguished from the deer tick without a microscope, is widely distributed in Maine. It usually feeds on wild animals such as woodchucks and racoons but will also feed readily on man and domestic animals.

Actual size 

Dermacentor variabilis, the common American "dog tick", is often found in southern Maine in late spring and early summer. It is usually easily distinguished by its larger size and characteristic white markings.

The deer tick, Ixodes dammini, which transmits Lyme disease, and the common dog tick, enlarged for comparison. The dog tick is not thought to transmit Lyme disease.

female male — Adult Deer Tick (Ixodes dammini)

female male — Adult Dog Tick (Dermacentor variabilis)

Precautions to be taken when walking in woods, brush or tall grass where ticks may be found include:

- Tuck your pant legs into your socks and your shirt into your pants. Deer ticks attach to clothing and then walk up.
- Wear light-colored clothing so ticks may be seen more easily.
- Use a repellant containing DEET according to label directions – particularly on shoes, socks, pant legs. Avoid applying high concentration products to the skin, particularly of children.
- To protect pets, consult your veterinarian for dusts or sprays.
- Inspect yourself, your clothing, your children, your companion, and your pets for ticks when you get in from the field. Shower, if possible.

Mowing grass and cutting brush in yards may reduce tick habitat in problem areas.

If you find a tick that is attached, remove it promptly because it takes at least several hours of feeding before the spirochete is transmitted. Don't handle the tick with bare hands. Grasp the tick as close to the skin as possible, preferably with fine tweezers, and pull gently but firmly until the tick lets go. Do not squeeze the tick. Apply antiseptic. Save the tick in a small bottle of 70% alcohol or rubbing alcohol. Common tick removal methods, such as scorching with a match, are not recommended because they may cause infected body fluids to be expelled into the skin.

The first symptom of Lyme disease is usually an expanding red rash at the site of the tick bite which may occur a few days or several weeks later. The rash may be preceeded or accompanied by flu-like symptoms such as fever, headache, chills, nausea, facial paralysis, or pain in muscles and joints. If Lyme disease is suspected, call your doctor immediately. Early antibiotic treatment can avoid later, more serious complications. Not all patients develop the rash, however, and many do not recall a tick bite.

In most animals, the rash apparently does not occur. Lameness, loss of appetite, fever, and lethargy may be the first indications. As in people, animals usually respond to prompt antibiotic therapy.

Research in Maine. Up to this time, very few deer ticks have been found further than 20 miles from coastal Maine. Research continuing this year will follow any expansion of this range and seek to determine if ecologic variables may limit the spread of Lyme disease.

Tick identification. If you find ticks you would like to have identified, send them in a small vial of alcohol, along with information including the name and age if from a person, kind of animal or other source, the location acquired, and the date found to one of these two laboratories:

Maine Lyme Disease Project
Maine Medical Center
Research Department
22 Bramhall Street
Portland, ME 04102

Insect and Disease Laboratory
(Maine Forest Service)
50 Hospital Street
Augusta, ME 04330

Produced by the Maine Lyme Disease Task Force.

EMERGENCY TELEPHONE NUMBERS

TABLE F-1
IN CASE OF EMERGENCY

HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA

Fire Department:	911
Military Police:	911
Ambulance:	911
Fire Prevention Office:	(609) 562-5484
Installation Safety Office:	Dick Campagna - Safety Coordinator (609) 562-3754
On-Site Medical Facility	Walson Army Hospital (609) 562-2695
USAEC Project Officer	Mike Svizzero (410) 671-1508
USAEC Safety and Environmental Services Branch:	William Houser (410) 671-4811 Work
ABB-ES HSM:	Cindy Sundquist (207) 775-5401 x3601
ABB-ES HSS:	Meg MacLeod (207) 775-5401 x3606
ABB-ES HSO:	Paul Bolmer (207) 775-5401 x3385

ROUTES TO EMERGENCY MEDICAL FACILITIES

DIRECTIONS TO EMERGENCY MEDICAL FACILITIES

1. Memorial Hospital of Burlington County
   175 Madison Ave.
   Mt. Holly, NJ 08060-2099
   Telephone: 609-267-0700
   Emergency Room Telephone: 609-261-7045

Directions:

From the Ft. Dix St. - Texas Ave. - Wrightstown Rd. traffic circle:

Take Route 545 (Wrightstown-Georgetown Rd.) north. Take a left (towards Mt. Holly) onto Route 537 to Madison Ave. Take a left onto Madison Ave; hospital is on the left. Approximate travel time is 20 to 30 minutes.

2. Kimball Medical Center
   600 River Ave.
   Lakewood, NJ 08701-5281
   Telephone: 908-363-1900

Directions:

From the Ft. Dix St. - Texas Ave. - Wrightstown Rd. traffic circle:

Take Route 545 (Trenton Rd.) south to Route 530 south. Turn left onto Route 70 east. Take a left onto Rt. 9 North (River Ave.) towards Lakewood. Hospital is on the left. Approximate travel time is 30 to 40 minutes.

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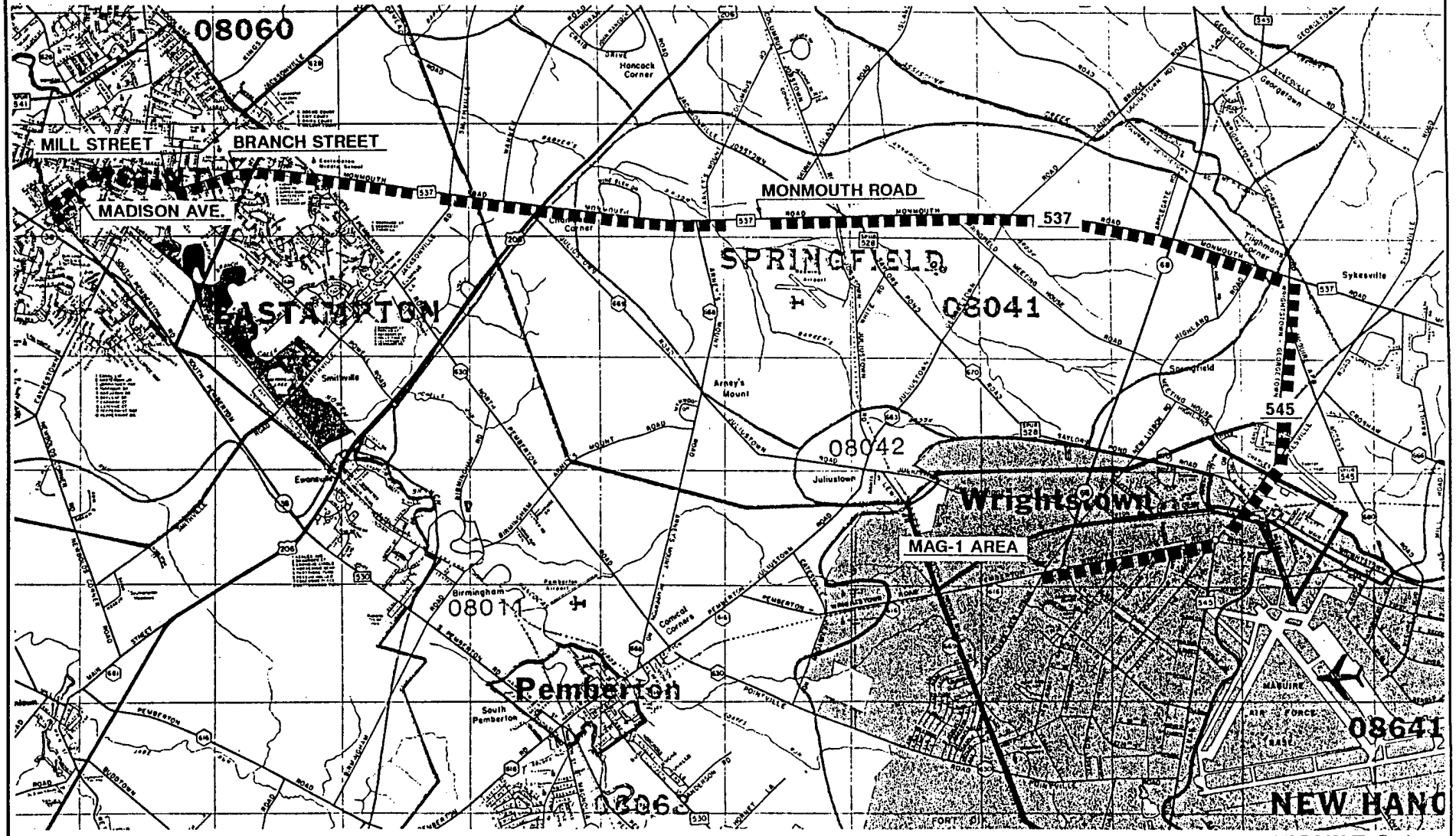
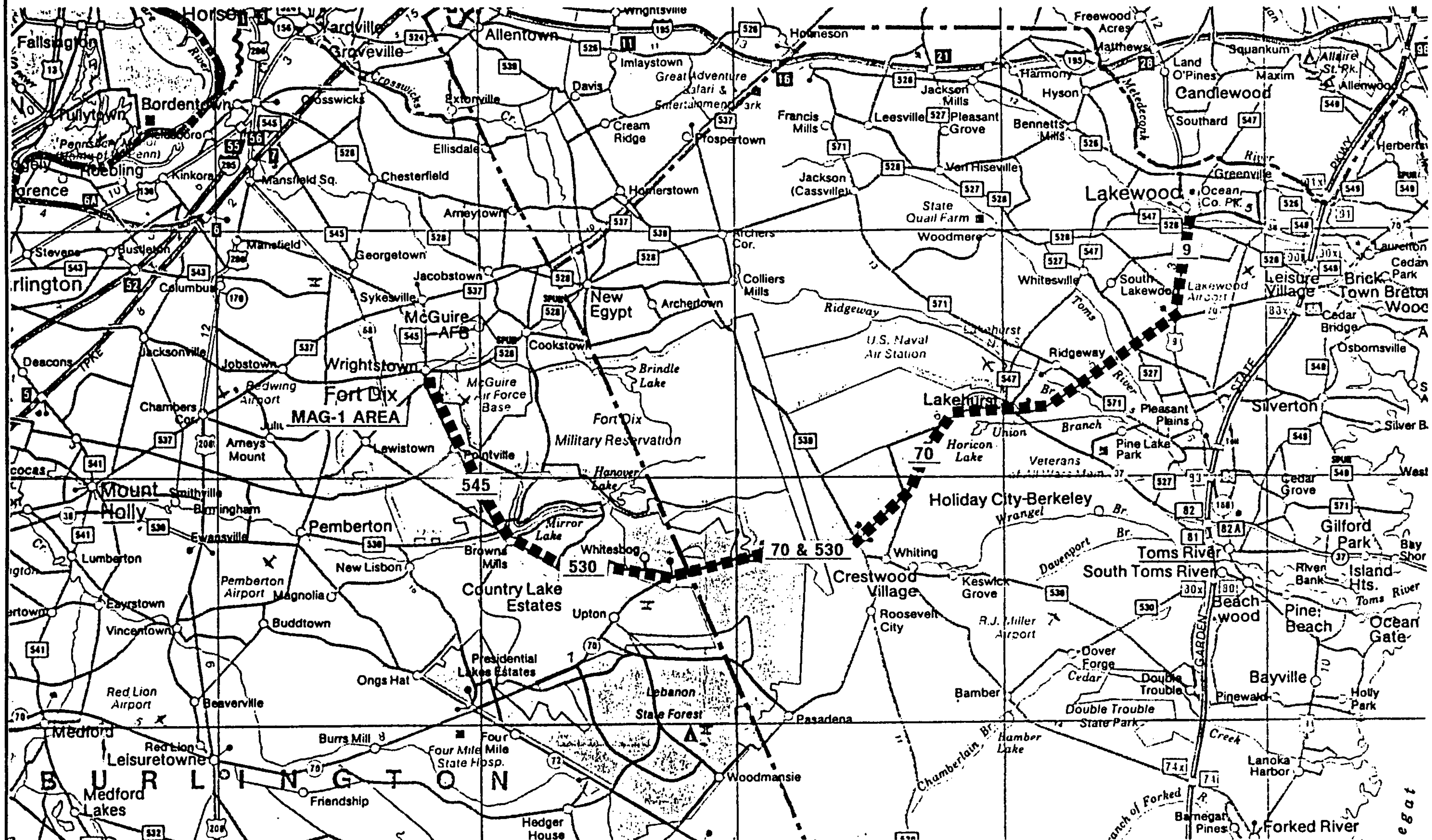


SOURCE: ALFRED B. PATTON, INC. MAP ENTITLED "BURLINGTON COUNTY, N.J. STREET & ROAD MAP" DATED 1993.

FIGURE G-1
PRIMARY EMERGENCY ROUTE
BURLINGTON COUNTY HOSPITAL
HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA

ABB Environmental Services, Inc.



SOURCE: HAGSTROM MAP COMPANY, INC. MAP ENTITLED "NEW JERSEY ROAD MAP" COPYRIGHTED 1990.

FIGURE G-2
ALTERNATE EMERGENCY ROUTE
KIMBALL MEDICAL CENTER
HEALTH AND SAFETY PLAN
FORT DIX RI/FS MAG-1 AREA

ABB Environmental Services, Inc.

U.S. ARMY ACCIDENT INVESTIGATION REPORT

U.S. ARMY ACCIDENT REPORT Instructions

General. The unit having the accident must investigate it and complete this report. Complete the shaded portions ***only*** for: Military off-duty, non-fatal accidents; and military on-duty accidents resulting in less than 20 lost workdays. Accidents involving 20 or more lost workdays and/or total property damage of $2,000 or more will require completion of the entire report. Type or legibly print the report. Items may be continued on a blank sheet of paper and attached to the report. Items listed below are keyed to the block numbers of DA Form 285, May 91. Items not listed here are self explanatory. Specific questions concerning this form should be referred to the local safety office.

SECTION A - Accident Information

Note: This section should be completed for the initial report and for any changes to a previously submitted report.

1. Check "INITIAL" if this is the first report on the accident. Check "CHANGE" if this report is a change to a previously submitted report of the accident.

2. Enter the 6-digit Unit Identification Code *(UIC)* for the unit responsible for the accident *(e.g., WXXXXX).*

Provide military unit information for the unit listed in Block *2*.

a. Full military address *(e.g., C Troop, 17 Cavalry, Ft. Bragg, NC 12345-6789).*

b. Provide the unit branch *(e.g., Armor, Infantry, Transportation).*

4. Enter the year, month, and day of the accident *(e.g., 90 11 07 {7 November 1990}).*

Enter the military time the accident occurred *(e.g., 0815, 2300).*

7. Check either item *a* or *b*, depending on the location of the accident.

If item *a* is checked, state name of post or installation *(e.g., Ft. Bragg, NC; Federal Center, Atlanta, GA; Ft. Hood, TX; Shaw AFB, SC).*

9. Check item *a* if accident occurred in a theater of hostile fire or enemy action, but not as a result of such fire/action. This includes direct preparation for combat, actual combat, or redeployment from a combat theater.

10. Check "Yes" of explosives *(C-4, TNT)*, ammunition, or pyrotechnics were involved and explain in Block *63* its involvement and specify the National Stock Number *(NSN).*

11. Give enough detail to find the exact location of the accident *(e.g., building number, street or highway name, state and/or country).* Also state the type of location *(e.g., road intersection, tank trail, family housing, firing range).*

SECTION B - Personnel Information

Note: Complete this section for each individual involved and/or injured in the accident. "Involved" means any person who was injured, or who took actions, or made decisions which caused or contributed to the accident. If more than one person was involved, enter information on one person on the initial form and complete only Sections A and B on additional forms for others. Staple all forms together.

16. Enter individual's rank/grade *(e.g., E5/SGT, O1/CPT, GS-11, WG-8).* Complete for all Government personnel.

17. Enter individual's full MOS/Job Series *(e.g., 54E20, 11B40, GS-301).*

18. Provide individual's full ***Military*** address for all Government personnel. If this address is not the same as that in Block *3a*, provide the unit UIC.

19. State how many continuous hours without sleep this individual was on-duty prior to the accident.

22. Indicate how many hours of continuous sleep this individual had in the past 24 hours.

23. State the estimated number of days this individual will be away from work *(totally unable to perform any work, bed rest/on quarters).* Does not include days hospitalized.

24. State the estimated *(or actual)* number of days this individual is hospitalized *(inpatient/admitted)* receiving treatment. Days hospitalized for "observation only" are not reported.

25. State the estimated number of days this individual will not be able to perform his or her regular duties *(light duty, profile).*

26. Check appropriate block. If more than one applies, check the most severe.

28. For this individual's "most severe injury", check the appropriate block(s) *(no more than 3)* that indicate the cause of the injury.

29. **Number** the body part(s) most seriously injured *(no more than 3)* in their order of priority *(the most serious first).* Be as specific as possible.

30. For each body part numbered in block *29*, place a corresponding number to indicate the type of injury received *(select only the most serious).*

31. Check the appropriate block that best describes the individual's action at the time of the accident. If Block *31gg* is checked, complete Blocks *76* and *77* of Section H, as indicated by these instructions.

32. Provide a short but detailed explanation of the item checked in Block *31*.

Note: For this report, the following definitions apply:

Tactical Training - Training in a field environment that uses or develops combat or combat support skills.

Field Exercise and Tactical Training - This begins when the individual reports to his or her primary duty location for movement to the field site and ends when he or she arrives back at the primary duty location from the field.

33. Check "Yes" if activity listed in Block *31* was part of a field exercise. State name of exercise if it has a name *(e.g., Team Spirit, Reforger).*

42. If vision enhancement device(s) were used, specify type and model numbers, and whether they caused the accident *(e.g., Night Vision Goggle, AN-PVS5A).*

43. Provide standard or reference *(Soldier's Manual, AR, TM, etc.)*, if it exists, that covers performance of the activity identified in Block *31*.

46. Provide a simple explanation of the mistake(s) or how the activity or task was performed incorrectly *(e.g., SGT Smith improperly backed his M915 truck without a ground guide).*

47. **In your opinion**, why was the mistake made or the activity performed incorrectly? Check the most important reason.

51. Check the block corresponding to the piece of equipment associated with the person in Block *12 (e.g., SGT Adams was driving the "at-fault" HMMWV; his name will be in Block 12, and his vehicle will be Item a in Section C below).*

SECTION C - Property/Material Involved

Complete Blocks *52-59* on each piece of property or item of equipment involved in the accident *(whether damaged or not).* Include Army and non-Army, as well as equipment whose use or misuse contributed to the accident. Include up to 3 items of equipment on the initial form. Use additional blank sheets of paper for other equipment if necessary, continuing letter sequence *(e.g., A, B, C, D, and E).*

52. Type of equipment *(e.g., sedan, truck, generator).*

53. Full military equipment model number or civilian make *(e.g., M109A2, M60A2, Ford Taurus, M16 Rifle).*

55. Estimated cost of damage *(ECOD)* or actual cost of damage *(ACOD)* for each piece of property, which includes costs of parts and labor.

57. Indicate if this specific item was being towed ***at the time of the accident.***

58. If Block *57* is "yes", indicate which item was doing the towing.

60. Complete for each component or part whose failure or malfunction contributed to the accident. Include the EIR/QDR number in Block *60e.*

61. Indicate how and why each component or part failed or malfunctioned by selecting from the lists provided and entering the appropriate number in the blocks provided.

SECTION D - Environmental Conditions Involved

62. Check the environmental conditions present at the time of the accident *(no more than 3)* by checking appropriate blocks, whether contributing to the accident or not. Also check whether they caused or contributed to the accident.

SECTION E - Accident Description/Narrative

63. Fully describe the sequence of events that lead up to and caused the accident. Explain how and why the accident occurred. Also include information required from Blocks *10* and *47*.

SECTION F - Corrective Action and Command Review

Note: The level of command review *(Company, Battalion, Division, etc.)* is determined by either the major Army command *(MACOM)* or installation policy.

65. Fully describe all actions taken, planned, or recommended to eliminate the cause(s) of this accident. Actions should be identified as appropriate at unit level, and all the way up to HQDA level.

SECTION G - SAFETY OFFICE USE ONLY

71. MACOM responsible for this accident *(FORSCOM, TRADOC, etc.).*

SECTION H - Special Interest/Supplemental Information

This section is for use by the U.S. Army Safety Center, MACOMs, or interested safety offices to obtain additional "Special Interest/Supplemental Information" on this accident as needed *(e.g., M1 tank fires, tactical parachute accidents, etc.).* Blocks *76* and *77* have been designated for collection of supplemental information on parachuting accidents.

Blocks *76* and *77*. If Block *31gg* was checked, provide the following supplemental information for each individual:

a. Name of jumper;
b. Jumper height;
c. Jumper weight;
d. Type of jump *(static line, non-tactical; static line, mass technical; freefall, non-tactical; freefall, tactical);*
e. Type of parachute and model;
f. Jumper's equipment *(list);*
g. Weight of equipment;
h. Wind direction and speed at
   (1) Jump height,
   (2) Drop zone;
i. Jump altitude;
j. Jumper's position in stick and door exited;
k. Time pre-jump conducted;
l. Date of last jump and type of jump;
m. Number of previous jumps;
n. Date graduated from basic airborne training *(year and month);*
o. Type of aircraft;
p. Accident cause(s): Improper exit, static line injury, broken static line, parachute malfunction, entanglement, lost or stolen air, oscillation, unstable position, dragged on DZ, tree landing, drop zone hazard *(specify)*, or other.

U.S. ARMY ACCIDENT REPORT

For use of this form, see AR 385-40, the proponent agency is OCSA

FOR USASC USE ONLY

Requirement Control Symbol CSOCS-308

SECTION A - ACCIDENT INFORMATION

1. CHECK ONE
   - ☐ a. INITIAL
   - ☐ b. CHANGE

2. UIC *(Unit Identification Code) (6-Digit Code of Unit Having Accident)*

3a. UNIT NAME AND MILITARY ADDRESS

3b. BRANCH *(Armor, Infantry, etc.)*

4. DATE OF ACCIDENT
   - a. YR.
   - b. MO.
   - c. DAY

5. TIME OF ACCIDENT *(Local Military Time)*

6. PERIOD OF DAY *(Check one)*
   - ☐ a. Day
   - ☐ b. Night

7. ACCIDENT OCCURRED *(Check one)*
   - ☐ a. On Post
   - ☐ b. Off Post

8. IF ON POST, NAME OF INSTALLATION/FACILITY

9. ACCIDENT OCCURRED DURING *(Check one)*
   - ☐ a. Combat
   - ☐ b. Non-Combat

10. WERE EXPLOSIVES OR AMMUNITION INVOLVED OR PRESENT?
   - ☐ Yes *(See Instruction Book)*
   - ☐ No

11. EXACT LOCATION OF ACCIDENT *(Detailed enough to locate site) (State type of location.)*

SECTION B - PERSONNEL INFORMATION

12. NAME *(Last, First, MI)*

13. SOCIAL SECURITY NUMBER *(SSN)*

14. AGE

15. SEX *(Check)*
   - ☐ a. Male
   - ☐ b. Female

16. RANK OR GRADE

17. MOS OR JOB SERIES

18. ADDRESS *(Use Official Address for All Military or Government Personnel) (If different than block 3, add UIC.)*

19. DUTY STATUS AT TIME OF ACCIDENT *(Check one)*
   - ☐ a. On Duty
   - ☐ b. Off Duty

20. FLIGHT STATUS *(Check one)*
   - ☐ a. Yes
   - ☐ b. No

21. CONTINUOUS DUTY *(hrs.) (Without sleep)*

22. HRS. SLEEP IN LAST 24

23. DAYS LOST *(Est. no. of days lost from work; not counting day of injury. Bed rest/on quarters.)*

24. DAYS HOSPITALIZED *(Est. no. of days hospitalized receiving treatment; not for observation only.)*

25. DAYS OF RESTRICTED WORK ACTIVITY *(Est. number of days person cannot perform regular duties; light duty/profile.)*

26. SEVERITY OF ILLNESS/INJURY *(Check One)*
   - ☐ a. **Fatal.**
   - ☐ b. **Permanent Total Disability.** Person can never again do gainful work.
   - ☐ c. **Permanent Partial Disability.** Person loses or can never again use a body part
   - ☐ d. **Days Away from Work.** Person misses one or more workdays; bed rest/on quarters.
   - ☐ e. **Restricted Work Activity.** Person is temporarily unable to perform regular duties; light duty/profile.
   - ☐ f. **First Aid Only** Person has one-time treatment of minor injury. *(No lost work days.)*
   - ☐ g. **No Injury.**

27. CLASSIFICATION AT TIME OF ACCIDENT *(Check)*
   - ☐ a. Active Army
   - ☐ b. Army Civilian
   - ☐ c. Army Contractor
   - ☐ d. Nonappropriated Fund *(NAF)*
   - ☐ e. Other U.S. Military
   - ☐ f. ROTC
   - ☐ g. Dependent
   - ☐ h. NGB Tech
   - ☐ i. NGB IDT
   - ☐ j. NGB AT
   - ☐ k. NGB ADSW
   - ☐ l. NGB AGR
   - ☐ m. NGB ADT
   - ☐ n. USAR IDT
   - ☐ o. USAR AT
   - ☐ p. USAR ADT
   - ☐ q. USAR FTM
   - ☐ r. Foreign Nat. Direct Hire
   - ☐ s. Foreign Nat. Indirect Hire
   - ☐ t. Foreign Nat. KATUSA
   - ☐ u. Foreign Mil. Attached to the U.S. ARMY
   - ☐ v. Public
   - ☐ w. Not reported

28. CAUSE OF INJURY/OCCUPATIONAL ILLNESS *(Check the most serious)*
   - ☐ a. Struck Against
   - ☐ b. Struck By
   - ☐ c. Fell from Elevation
   - ☐ d. Fell from Same Level
   - ☐ e. Caught In/ Under/ Between
   - ☐ f. Rubbed/abraded
   - ☐ g. Bodily Reaction
   - ☐ h. Overexertion
   - ☐ i. Exposure
   - ☐ j. External Contact
   - ☐ k. Ingested
   - ☐ l. Inhaled

29. BODY PART(S) AFFECTED *(Check primary) (No more than 3)*
   - ☐ a. Body *(General)*
   - ☐ b. Head
   - ☐ c. Forehead
   - ☐ d. Eyes
   - ☐ e. Nose
   - ☐ f. Jaw
   - ☐ g. Neck
   - ☐ h. Trunk
   - ☐ i. Chest
   - ☐ j. Heart
   - ☐ k. Back
   - ☐ l. Shoulder
   - ☐ m. Arm
   - ☐ n. Wrist
   - ☐ o. Hand
   - ☐ p. Fingers
   - ☐ q. Leg
   - ☐ r. Knee
   - ☐ s. Ankle
   - ☐ t. Foot
   - ☐ u. Toes
   - ☐ v. OTHER *(Specify)*

30. TYPE OF INJURY/ILLNESS *(Check the most serious)*
   - ☐ a. Burns *(Chemical)*
   - ☐ b. Burns *(Thermal)*
   - ☐ c. Amputation
   - ☐ d. Decompression Sickness
   - ☐ e. Asphyxiation *(Suffocation)*
   - ☐ f. Fractures
   - ☐ g. Dislocation
   - ☐ h. Abrasions
   - ☐ i. Concussion
   - ☐ j. Sprain/Strain
   - ☐ k. Cuts/Lacerations
   - ☐ l. Contusion
   - ☐ m. Puncture Wound
   - ☐ n. Hernia, Rupture
   - ☐ o. Frostbite
   - ☐ p. Heat Stroke
   - ☐ q. Heat Exhaustion
   - ☐ r. Noise Injury/Illness

SECTION B - PERSONNEL INFORMATION *(Continued)*

31. Person's action(s) at time of accident *(Check one and explain in Block 32.)*

a. Soldiering	j. Test/Study/Experiments	s. Fabricating	aa. Hobbies
b. Combat Soldiering	k. Educational	t. Handling Material/Passengers	bb. Passenger
c. Physical Training	l. Information and Arts	u. Janitorial/ Housekeeping/ Grounds Keeping	cc. Human movement
d. Weapons Firing	m. Food and Drug Inspection		dd. Horseplay
e. Engineering or Construction	n. Laundry/Dry Cleaning Services	v. Food/Drink Preparations	ee. Bystanding/spectating
f. Communications	o. Pest/Plant Control	w. Supervisory	ff. Personal Hygiene/Food/Drink Consumption/Sleeping
g. Security/Law Enforcement	p. Operating Vehicle or Vessel	x. Office	gg. Parachuting *(See Instructions)*
h. Fire Fighting	q. Handling Animal	y. Counseling/Advisory	
i. Patient Care *(People/Animals)*	r. Maintenance/Repair/Servicing	z. Sports	

32. SPECIFIC DESCRIPTION OF ACTIVITY/TASK

33. ON FIELD EXERCISE *(Check one)*

☐ a. Yes (If YES, specify name of exercise.)

☐ b. No

34. ACTIVITY PART OF TACTICAL TRAINING? *(Check one)*

☐ a. Yes

☐ b. No

35. Type of training facility being used *(Check one)*

a. Garrison	d. NTC	g. Std. range facility/ live fire
b. Local training area	e. JRTC	h. Other *(Specify)*
c. Major training area	f. CMTC	

36. Type of training participating in at the time of accident *(Check/specify)*

a. School *(Specify)*			
b. Unit →	(1) Platoon	(2) Crew	(3) Individual
c. On-the-job training	d. Other *(Specify)*		

37. Last time individual received training prior to accident on activity specified in block 31? *(Check one)*

a. 0 - 3 months	e. 1 - 2 years
b. 3 - 6 months	f. More than 2 years
c. 6 - 9 months	g. Never
d. 9 - 12 months	h. Not applicable

38. Required protective equipment

CHECK APPROPRIATE BLOCK(S)	AVAILABLE? YES	AVAILABLE? NO	USED? YES	USED? NO	N/A
a. Seat belt					
b. Helmet					
c. Goggles/glasses					
d. Gloves					
e. Ear plugs					
f. Other *(Specify)*					

39. INDIVIDUAL LICENSED TO OPERATE VEHICLE/EQUIPMENT? *(Check one)*

☐ a. Yes ☐ b. No ☐ c. N/A

40. DID ALCOHOL CAUSE/CONTRIBUTE TO THIS ACCIDENT? *(Check one)*

☐ a. Yes ☐ b. No ☐ c. Unknown

41. If drugs caused/ contributed to this accident, check appropriate block.

a. Prescription
b. Illegal
c. Over-the-counter
d. None

42. Were vision enhancement devices being used? *(Check appropriate block.)*

a. Yes *(Specify type/model in c and d.)*	
b. No	
c. TYPE	d. MODEL

43. Standard/Reference covering activity/task

a. Soldier's Manual *(Task No.)*	
b. CTT *(Task No.)*	
c. AR/TM/FM *(Specify)*	
d. SOP	e. None *(Go to block 45.)*

44. WAS ACTIVITY/TASK PERFORMED IAW STANDARD/REFERENCE? *(Check one)*

☐ a. Yes ☐ b. No *(If NO, complete blocks 46-47.)*

45. DID INDIVIDUAL MAKE A MISTAKE? *(Check one)*

☐ a. Yes *(If YES, complete blocks 46-47.)* ☐ b. No

46. What was the mistake? How was the activity/task performed incorrectly? *(Explain below.)*

47. Why was mistake made/activity performed incorrectly? *(Check the most important reason and specify in Block 63.)*

a. Inadequate school training *(content/amount)*	f. In a hurry	k. Inadequate services
b. Inadequate unit training *(content/amount)*	g. Poor/bad attitude	l. Improper equipment design
c. Inadequate on-the-job training *(content/amount)*	h. Lack of rest/sleep	m. Inadequate written procedures *(AR, TM, SOP)*
d. Fear/ excitement	i. Effects of alcohol/drugs	n. Improper supervision
e. Overconfident in own/others abilities	j. Inadequate facilities	o. Other *(Specify in narrative)*

SECTION B - PERSONNEL INFORMATION *(Continued)*

48. Time licensed on this vehicle *(Check one)*	49. Total AMV driving mileage *(Check one)*	50. Total time in unit *(Check one)*
☐ a. Less than one year	☐ a. Less than 1,000 miles	☐ a. Less than 6 months
☐ b. One to two years	☐ b. 1,000 - 5,000 miles	☐ b. 6 months - 1 year
☐ c. Over two years	☐ c. 5,000 - 10,000 miles	☐ c. Over one year
☐ d. Unlicensed	☐ d. Over 10,000 miles	

51. WHICH ITEM FROM SECTION C APPLIES TO THE INDIVIDUAL NAMED IN BLOCK 12? *(This is needed in order to relate the person in block 12 to the equipment/vehicle below.)*

☐ Item A ☐ Item B ☐ Item C ☐ OTHER *(Specify)*

SECTION C - PROPERTY/MATERIAL INVOLVED *(Whether Damaged or Not)*

	ITEM A	ITEM B	ITEM C
52. Type of item			
53. Model number			
54. Ownership *(DOD, DA, POV, Unit, Person)*			
55. Dollar cost of damage			
56. Rollover protection system installed?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
57. Was this item being towed?	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA	☐ Yes ☐ No ☐ NA
58. If towed, enter letter for item doing towing			
59. Types of collision codes *(Pick up to three from list below and enter in blocks.) (In sequence.)*			

Types of Collisions

1 - Going forward and collided with moving vehicle
2 - Going forward and collided with parked vehicle
3 - Collision while backing
4 - Collision with pedestrian
5 - Collision with object (other than vehicle/pedestrian
6 - Overturned
7 - Ran off the road
8 - Jackknifed
9 - Going forward and rear-ended moving vehicle
10 - Going forward and rear-ended parked vehicle
11 - Collision while turning
12 - Other *(Specify)*

60. Component/Part that Failed/Malfunctioned ***(Complete this section if a materiel failure/malfunction caused/contributed to the accident.)***

	ITEM A	ITEM B	ITEM C
a. National Stock Number			
b. Part Number			
c. Describe Part			
d. Manufacturer's Identification Code			
e. EIR/QDR Number			

61. How/Why Part Malfunctioned *(Select code from "How" list below and enter in first block; select code from "Why" list and enter in second block.)*	HOW	WHY	HOW	WHY	HOW	WHY

***How Part Failed/Malfunctioned* Codes**

1 - Overheated/burned/melted
2 - Froze *(temperature)*
3 - Obstructed/pinched/clogged
4 - Vibrated
5 - Rubbed/worn/frayed
6 - Corroded/rusted/pitted
7 - Overpressured/burst
8 - Pulled/stretched
9 - Twisted/torqued
10 - Compressed/hit/punctured
11 - Bent/warped
12 - Sheared/cut
13 - Decayed/decomposed
14 - Electric current action
15 - Unknown/Other
Blank - Not reported

***Why Part Failed/Malfunctioned* Codes**

1 - Improper equipment design
2 - Inadequate maintenance
3 - Inadequate manufacture of equipment
4 - Inadequate written procedures *(AR, TM, SOP)*
5 - Improper supervision
6 - Unknown
7 - Other *(Specify in narrative)*

SECTION D - ENVIRONMENTAL CONDITIONS INVOLVED

62. Environmental conditions. *(Check environmental conditions present and indicate if condition caused/contributed to the accident.)*

PRESENT	CAUSED/ CONTRIBUTED	CONDITION	PRESENT	CAUSED/ CONTRIBUTED	CONDITION
		a. Clear/dry; visibility unlimited			k. Wind gust/turbulence
		b. Bright, glare			l. Vibrate, shimmy, sway, shake
		c. Dark, dim			m. Radiation, laser, sunlight
		d. Fog, condensation, frost			n. Holes, rocky rough, rutted, uneven
		e. Mist, rain, sleet, hail			o. Inclined/steep
		f. Snow, ice			p. Slippery *(not due to precipitation)*
		g. Dust, fumes, gasses, smoke, vapors			q. Air pressure *(bends, decompression, altitude, hypoxia)*
		h. Noise, bang, static			r. Lightning, static electricity, ground
		i. Temperature/humidity *(cold, heat)*			s. OTHER *(Specify)*
		j. Storm, hurricane, tornado			

SECTION E - ACCIDENT DESCRIPTION/NARRATIVE *(From blocks 10, 47)*

63. GIVE THE SEQUENCE OF EVENTS THAT AMPLIFY/EXPLAIN WHAT HAPPENED, LEADING UP TO AND INCLUDING THE ACCIDENT. *(Explain why accident happened.)*

64a. PRINTED/TYPED NAME OF PERSON COMPLETING THIS REPORT	64b. RANK	64c. TITLE	
64d. SIGNATURE		64e. DATE OF SIGNATURE *(YY/MM/DD)*	64f. TELEPHONE NO.

SECTION F - CORRECTIVE ACTION AND COMMAND REVIEW

65. DESCRIBE THE ACTIONS TAKEN, PLANNED, OR RECOMMENDED TO ELIMINATE THE CAUSE(S) OF THIS ACCIDENT *(from unit level up to HQDA)*.

66a. PRINTED/TYPED NAME OF COMMANDER	66b. RANK

66c. SIGNATURE	66d. DATE OF SIGNATURE *(YY/MM/DD)*	66e. TELEPHONE NO.

	a. TYPED NAME	b. SIGNATURE	c. TITLE	d. RANK / DATE
67				
68				
69				

SECTION G - *SAFETY OFFICE USE ONLY*

70. LOCAL REPORT NO.	71. MACOM

72. **Accident type** *(Check choice)*

	a. Army Motor Vehicle		h. Other Army Vehicle		o. Personal Injury - Other
	b. Army Combat Vehicle		i. Fire		p. Property Damage - Other
	c. Army Operated Vehicle		j. Chemical Agent		q. POV - On Official Business
	d. POV - Not on Official Business		k. Explosive		r. Space
	e. Marine Diving		l. Missile		s. Commercial Carrier/Transportation
	f. Marine Underway		m. Radiation		
	g. Marine Not Underway		n. Nuclear		

73. NAME OF SAFETY POINT OF CONTACT *(POC)*	74. PHONE NO. OF SAFETY OFFICE POC *(AUTOVON, Commercial, Etc.)*	75. DATE REPORT COMPLETED BY SAFETY OFFICE *(YY/MM/DD)*

SECTION H - SPECIAL INTEREST AND/OR SUPPLEMENTAL INFORMATION

76.	
77.	
78.	
79.	

PERMIT REQUIRED CONFINED SPACES

APPENDIX I
PERMIT-REQUIRED CONFINED SPACES

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APPENDICES

APPENDIX I
PERMIT REQUIRED CONFINED SPACES

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PERMIT-REQUIRED CONFINED SPACES

I.1.0 INTRODUCTION

A worker entering a confined space can be exposed to multiple hazards if conditions are not understood or safety regulations are not enforced. Most accidents result from failure of workers to recognize a confined space as a potential hazard. Ignorance and negligence have led to a number of deaths each year by asphyxiation, fire and explosion, and/or fatal exposure to toxic materials (Table H-1). Because of this, OSHA developed the Permit-Required Confined Spaces Standard (29 CFR 1910.146).

ABB-ES associates may encounter a variety of confined spaces when working at hazardous waste sites. As the confined spaces found at hazardous waste sites are typically unknown and usually required only a single entry, all spaces will be considered permit-required unless otherwise allowed by the Health and Safety Manager (HSM).

Before entry into a confined space is permitted, the Health and Safety Officer (HSO) will ensure that the Health and Safety Plan (HASP) addresses the entry and that the entry permit has been issued. Items that will be addressed in the HASP and/or the Permit will include the following:

- Measure to use to prevent unauthorized entry.
- Identification and evaluation of the hazards.
- Means, procedures, and practices necessary for safe entry.
- Availability and proper use of required equipment.
- Procedures to determine if acceptable entry conditions exist and that they are maintained before and during entry.
- Testing or monitoring of space to ensure acceptable conditions are maintained.
- Identification of associates with active roles such as authorized entrants, attendants, entry supervisor, and rescue including assignment of duties.

TABLE I-1
ACCIDENTS AND ILLNESS TYPE
CONFINED SPACE (CS)

REF. NO.	ACCIDENT AND ILLNESS TYPE	EVENTS	INJURIES	FATALITIES
1	Atmospheric Condition in CS	80	72	78
2	Explosion or Fire in CS	15	49	15
3	Explosion or Fire at Point-of-Entry to CS	23	20	32
4	Electrocution or Electrical Shock	11	2	9
5	Caught In/Crushing of CS	10	3	10
6	Trapped in Unstable Materials in CS	16	0	16
7	Struck by Falling Objects in CS	15	1	14
8	Falls (while in CS; not into CS)	27	26	1
9	Ingress/Egress of CS	33	30	3
10	Insufficient Maneuverability in CS	15	15	0
11	Eye Injury in CS	10	10	0
12	Contact with Temperature Extreme in CS	7	4	3
13	Noise in CS	1	1	0
14	Vibration in CS	1	1	0
15	Stress from Excess Exertion in CS	12	0	12
Totals		276	234	193

Safety Sciences, San Diego, California - 1977 [1]

- Training
- Rescue procedures
- Permit preparation, issuance, use, and cancellation.
- Coordination of entry with subcontractor.
- Review of entry operations

I.2.0 MEASURES TO PREVENT UNAUTHORIZED ENTRY

Depending on site conditions, the actual confined space plus a suitable area around the entrance will be considered the Exclusion Zone. Only those who meet the training requirements of The Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) and the Permit-Required Confined Spaces (29 CFR 1910.146) will be allowed in this area.

The perimeter of the Exclusion Zone will be identified by flagging or some other method The actual confined space will remain sealed, locked, or otherwise protected until authorization for entry is given. If the entryway into the confined space cannot be protected from unauthorized entry, a sign stating **DANGER - PERMIT REQUIRED CONFINED SPACE, DO NOT ENTER** will be placed on or near the entry. It is the responsibility of the HSO to ensure that the above procedures are followed.

I.3.0 IDENTIFICATION AND EVALUATION OF HAZARDS

When evaluating a confined space and determining its exposure potential, both physical and chemical hazards must be considered.

I.3.1 PHYSICAL CLASSIFICATION

Confined Spaces are defined as areas large enough and so configured that an employee can enter the space and perform assigned work, has limited or restricted access, and is not designed for continuous occupancy. Confined spaces can be categorized generally as those with open tops and a depth that restricts the natural movement of air, and those with very limited openings for entry. In either case, the space may contain electrical or mechanical equipment with moving parts. Any combination of these parameters changes the nature of the hazards encountered. Degreasers, pits, and certain types of storage tanks may be classified as open-top confined spaces that usually contain no moving parts. However, gases that are heavier than air (i.e., butane, propane, and other hydrocarbons) remain in depressions and will flow to low points where they are difficult to remove. Open-top water tanks or test pits that appear harmless may develop toxic atmospheres (e.g., hydrogen sulfide or chlorinated hydrocarbons) from the vaporization of contaminated water or soil. Therefore, these heavier-than-air gases are a primary concern when entering such a confined space. Other hazards may develop due to the work performed in the confined space or corrosive residues that accelerate the decomposition of scaffolding supports and electrical components.

Confined spaces such as sewers, casings, tanks, silos, vaults, and compartments of ships usually have limited access. The problems associated with entry into these areas are similar to those that occur in open-top confined spaces. However, limited access increases the risk of injury. Heavier-than-air gases (e.g., carbon dioxide and propane) may lie in a tank or vault for hours or even days after the container is opened. Because some gases are odorless, the hazard may be overlooked, with fatal results. Lighter-than-air gases may also be trapped within an enclosed-type confined space, especially those with access from the bottom or sides.

The most hazardous confined space is one that combines limited access and mechanical or electrical devices. All the hazards of open-top and limited-access confined spaces may be present, together with the additional hazard of moving parts. Digesters and boilers usually contain power-driven equipment which, unless properly isolated, may inadvertently be activated after entry. Such equipment may also contain physical hazards that further complicate the work environment and the entry and exit process.

I.3.1.1 Physical Hazards

Physical hazards that may be encountered in a confined space include non-chemical, physiologic stresses such as thermal effects (heat and cold), noise, vibration, radiation, and fatigue.

I.3.1.1.1 Thermal Effects

Four factors influence the interchange of heat between humans and the environment:

- air temperature
- air velocity
- moisture contained in the air
- radiant heat

Because of the nature and design of most confined spaces, moisture content and radiant heat are difficult to control. As the body temperature rises progressively, a worker continues to function until the body temperature reaches 38.3° to 39.4°C (101° to 103°F). When this body temperature is exceeded, the worker is less efficient, and is prone to heat exhaustion, heat cramps, or heat stroke. In a cold environment, certain physiologic mechanisms come into play that tend to limit heat loss and increase heat production. The most severe strain in cold conditions is the chilling of extremities so that activity is restricted. Special precautions must be taken in cold environments to prevent frostbite, trench foot, and general hypothermia.

I.3.1.1.2 Noise

Noise problems are usually intensified in confined spaces because the interior tends to cause sound to reverberate, thus exposing the worker to audio levels higher than in an open environment. Intensified noise increases the risk of hearing damage to workers, which could result in temporary or permanent hearing loss, and/or could cause disorientation and affect the workers' ability to function even to the extent that they are unable to escape from the space. Noise in a confined space that may not be intense enough to cause hearing damage may still disrupt verbal communication with the emergency standby person outside the confined space. If the workers inside cannot hear commands or danger signals due to excessive noise, the probability of severe accidents can increase.

I.3.1.1.3 Other Physical Hazards

Some physical hazards cannot be eliminated because of the nature of the confined space or the work to be performed, including items such as scaffolding, surface residues, and structural hazards. The use of scaffolding in confined spaces has contributed to many accidents caused by workers or materials falling, improper use of guardrails, and lack of maintenance to ensure worker safety. The choice of material used for scaffolding depends on the type of work to be performed, the calculated weight to be supported, the surface on which the scaffolding is placed, and the substance previously stored in the confined space.

Surface residues in confined spaces can increase the already hazardous conditions of electrical shock, reaction of incompatible materials, liberation of toxic substances, and bodily injury due to slips, trips, and falls. Without protective clothing, additional health hazards may arise due to surface residues.

Structural hazards within a confined space (e.g., baffles in horizontal tanks, trays in vertical towers, bends in tunnels, overhead structural members, or scaffolding installed for maintenance) constitute physical hazards that are exacerbated by the physical surroundings. In dealing with structural hazards, workers must review and enforce safety precautions to ensure safety.

Rescue procedures may require withdrawal of an injured or unconscious person. Careful planning must be given to the relationship between the internal structure, the exit opening, and the worker. Provisions must be made so the victim is positioned in front of the opening in such a configuration that he/she can be removed from the space. If the worker is above the opening, the system must include a rescue arrangement operated from outside the confined space, if possible, by which the worker can be lowered and removed without injury.

I.3.2 Chemical Classifications

Confined spaces are also classified according to existing or potential chemical hazards. The classification is based on characteristics of the confined space, oxygen level, flammability, and toxicity. Table G-2 defines the parameters of each classification. If any of the hazards present a situation that is Immediately Dangerous to Life and Health (IDLH), the confined space is designated as Class A and requires Level A or B personal

Table I-2
Confined Space Classification Table

PARAMETERS	CLASS A (LEVEL A OR B PPE)	CLASS B (LEVEL B OR C PPE)	CLASS C (LEVEL D PPE)
Characteristics	Immediately dangerous to life: rescue procedures require the entry of more than one individual fully equipped with life-support equipment; maintenance of communication requires an additional standby person stationed within the confined space.	Dangerous, but not immediately life-threatening: rescue procedures require the entry of no more than one individual fully equipped with life-support equipment; indirect visual or auditory communication with workers.	Potential hazard requires no modification of work procedures: standard rescue procedures, direct communication with workers from outside the confined space.
Oxygen	19.4 percent or less *(122-mm Hg) or greater than 23.5 percent *(190 mm Hg)	19.5 to 20.9 percent *(122- to 147-mm Hg) or 20.9 to 23.5 percent (163- to 190-mm Hg)	19.5 to 20.9 percent *(148- to 163-mm Hg)
Flammability Characteristics	20 percent or greater LEL	10 to 19 percent LEL	10-percent LEL or less
Toxicity	**IDLH	Between the TLV/PEL and the **IDLH. If air-purifying respirators are used, maximum level based on breakthrough time (1,000 ppm maximum).	Less than the TLV/PEL.
Respiratory Protection	SCBA or supplied air respirator with escape bottle.	SCBA, supplied air respirator with escape bottle or air-purifying respirator.	None.

* Based on total atmospheric pressure of 760-mm Hg (sea level).

** Immediately Dangerous to Life and Health, as referenced in NIOSH Registry of Toxic and Chemical Substances, Manufacturing Chemists data sheets, industrial hygiene guides, or other recognized authorities.

Notes: Hg = mercury; LEL = Lower Explosive Limit; PEL = Permissible Exposure Limit; SCBA = Self-Contained Breathing Apparatus; TLV = Threshold Limit Value PPE = Personal Protective Equipment

protective equipment. The classification is determined by the most hazardous condition of entering, working in, and exiting a confined space. Class B confined spaces have the potential for causing injury and illness, but are not IDLH (Level B or C personal protective equipment). A Class C confined space is one in which the chemical hazard potential is minimal and does not require any special modification in work procedures (Level D personal protective equipment).

I.3.2.1 Hazardous Atmospheres

Hazardous atmospheres encountered in confined spaces can be divided into four categories: (1) oxygen-deficient, (2) flammable, (3) toxic, and (4) irritant and/or corrosive.

I.3.2.1.1 Oxygen-Deficient Atmosphere

The normal atmosphere is composed of approximately 20.9 percent oxygen, 78.1 percent nitrogen, and 1 percent argon, with small amounts of various other gases. Reduction of oxygen in a confined space may be the result of either consumption or displacement.

The consumption of oxygen occurs during combustion of flammable substances, as in welding, heating, cutting, and brazing. A more subtle consumption of oxygen occurs biologically (e.g., during the bacterial action of the fermentation process). Oxygen may also be consumed during chemical reactions (e.g., formation of rust [iron oxide] on the exposed surface of the confined space).

A second cause of oxygen deficiency is displacement by another gas. Helium, argon, and nitrogen are examples of gases that are intentionally used to displace air and which therefore reduce the oxygen level. Carbon dioxide may be intentionally introduced to displace air, but can also naturally displace air (e.g., in sewers, storage bins, wells, tunnels, wine vats, and grain elevators).

I.3.2.1.2 Flammable Atmosphere

A flammable atmosphere generally arises from vaporization of flammable liquids, by-products of work, chemical reactions, enriched-oxygen atmospheres, concentrations of combustible dusts, and desorption of chemicals from inner surfaces of the confined space. An atmosphere becomes flammable when, in the presence of oxygen, the concentration

is neither too rich nor too lean to burn. Combustible gases or vapors will accumulate when there is inadequate ventilation in an area (e.g., a confined space). Flammable gases (e.g., acetylene, butane, propane, hydrogen, methane, natural or manufactured gases, or vapors from liquid hydrocarbons) can be trapped in a confined space. Heavier-than-air gases will seek lower levels (as in pits, sewers, and various types of storage tanks and vessels). In a closed-top tank, lighter-than-air gases may rise and develop a flammable concentration if trapped at the top of the tank.

I.3.2.1.3 Toxic Atmosphere

The substances regarded as toxic in a confined space can cover the entire spectrum of gases, vapors, and finely divided airborne dust in industry. The forces of toxic atmospheres encountered may arise from the manufacturing process (e.g., in producing polyvinyl chloride, hydrogen chloride is used, as well as a vinyl chloride monomer, which is carcinogenic); the product stored (e.g., removing decomposed organic material from a tank can liberate toxic substances such as hydrogen sulfide); and the operation performed in the confined space (e.g., welding or brazing with metals capable of producing toxic fumes).

I.3.2.1.4 Irritant (Corrosive) Atmosphere

Irritant or corrosive atmospheres can be divided into primary and secondary groups. Primary irritants show responses at the point of contact and generally exert no systemic toxic effects. Examples of primary irritants are chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide. A secondary irritant is one that may produce systemic toxic effects in addition to surface irritation; for example, benzene, carbon tetrachloride, ethyl chloride, 1,1,1-trichloroethane, trichloroethylene, and 3-chloropropylene.

Prolonged exposure to irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This has been interpreted to mean that the worker has adapted to the harmful agent involved. In reality, it means there has been a general weakening of the body's defense reflexes due to damage of the nerve endings in the mucous membranes of the conjunctive and upper respiratory tract. The danger in this situation is that the worker is usually not aware of any decrease in his/her reaction to the toxic substance.

I.3.3 General Safety Hazards

I.3.3.1 Communication Problems

Communication between the worker inside a confined space and the standby person outside is of utmost importance. If the worker suddenly feels distressed and is not able to summon help, this condition could result in a fatality. Frequently, the body positions assumed in a confined space make it difficult for the standby person to detect an unconscious worker. When visual monitoring of the worker is not possible because of the design of the confined space or location of the entry hatch, a voice- or alarm-activated, explosion-proof-type communication system is necessary.

Suitable and approved illumination is required to provide sufficient visibility for work. Illumination must be intrinsically safe and explosion-proof.

I.3.3.2 Entry and Exit

Entry and exit time can be of major significance if the physical limitations of the entryway hinder the rescue of an injured person. The degree of significance is directly related to the potential hazard of the confined space. The extent of precautions taken and the standby equipment needed to maintain a safe work area are determined by the means of access and rescue. The following should be considered: type of confined space to be entered; access to the entrance; number and size of openings; barriers within the space; maximum occupancy; and time required for exiting in the event of fire or vapor incursion, or to rescue injured workers.

I.4.0 GENERAL WORK PRACTICES

Before entry into a confined space is allowed, the HSO will ensure that procedures necessary to ensure safe permit entry are, identified, developed and implemented. These procedures may include purging and ventilation, and isolation (lock-out/tag-out),

I.4.1 PURGING AND VENTILATION

For entering and working in a confined space, environmental control is accomplished by purging and ventilation. Purging is the initial step in adjusting the atmosphere in a confined space to acceptable standards (i.e., Permissible Exposure Limits [PELs], Threshold Limit Values [TLVs], and LELs). This is accomplished either by displacing the atmosphere in the confined space with fluid or vapor (i.e., inert gas, water, steam, and/or cleaning solution) or by forced-air ventilation.

The method used to purge or ventilate the confined space will be determined by the potential hazards that arise due to the product stored or produced, the suspected contaminants, the work to be performed, and the design of the confined space. When ventilating and/or purging operations are to be performed, the blower controls must be at a safe distance from the confined space. When a ventilation system is operational, air flow measurements (as well as atmosphere testing) must be made before each entry to ensure that a safe environmental level is maintained. Initial testing of the atmosphere should be performed from outside the confined space before ventilation begins to determine precautions necessary for purging and ventilating. Testing of more remote regions within the confined space may be performed once the immediate area within the confined space has been made safe. Exhaust systems should be designed to protect workers in the surrounding area from exposure to contaminated air. If flammable concentrations are greater or equal to 10 percent of the LEL, all electrical equipment must be intrinsically safe and explosion-proof. Continuous ventilation is required by OSHA where ever feasible. The atmosphere must be tested until acceptable levels of oxygen and contaminants are continuously maintained for three tests at 5-minute intervals. Care must be taken to prevent recirculation of contaminated air and interaction of airborne contaminants.

Continuous general ventilation should be maintained where toxic atmospheres may develop due to the nature of the confined space or the activities being performed, as i n the case of desorption from walls or evaporation of residual chemicals. General ventilation is an effective procedure for distributing contaminants from a local generation point throughout the work space to obtain maximum dilution. However, special precautions must be taken if the ventilating system partially blocks the exit opening, including methods for providing respirable air to each worker for the time necessary to exit and for maintaining communications.

I.4.2 ISOLATION/LOCK-OUT/TAGGING

Isolation procedures must be specific for each type of confined space. Safety equipment required during this procedure will be designated by the HSO and will depend on potential hazards involved. A Class A or B confined space must be completely isolated from all other systems by physical disconnection, double-block and bleed, or blanking off all lines. In continuous systems, where complete isolation is not possible (e.g., sewers or utility tunnels), specific written safety procedures must be used. Shutoff valves, serving the confined space, must be locked in the closed position and tagged f or identification. In addition to blanking, pumps and compressors serving the lines entering the confined space must be locked out to prevent accidental activation. If a drain line is located within the confined space, provision must be made, when necessary, to tag it and leave it open; this will be recorded in the HASP.

Electrical isolation of the confined space to prevent accidental activation of moving parts that would be hazardous to workers is achieved by locking circuit breakers and/or disconnects in the open (off) position with a key-type padlock. The only key to the padlock is to remain with the person working inside the confined space. If more than one person is inside the confined space, each person must place his own lock on the circuit breaker. In addition to the lockout system, there must be an accompanying tag that identifies the operation and prohibits use.

Mechanical isolation of moving parts can be achieved by disconnecting linkages or removing drive belts or chains. Equipment with moving mechanical parts must also b e blocked to prevent accidental rotation.

I.5.0 EQUIPMENT

The HSO will ensure that prior to entering a confined space, all required equipment is present on site, in good working order, and that all associates are knowledgeable in their use. The HASP and entry Permit will include a list of necessary protective equipment to be used in the confined space, as determined by the HSO. Items to consider include head, eye, face, and foot protection against traumatic injury, respiratory, hand, and body protection for chemical hazards injuries, as well as ventilating, monitoring and rescue equipment.

Equipment that may be required on sites includes the following:

- Testing and monitoring equipment
- Ventilating equipment
- Communication equipment
- Personal protective equipment
- Lighting equipment
- Barriers and shields
- Ladders or other means of ingress or egress
- Rescue and emergency equipment
- Other

Standard items required at all sites are identified on the entry permit.

I.5.1 Eye and Face Protection

If eye-irritating chemicals, vapors, or dusts are present, safety goggles are required, unless a full-face respirator is used. If both the face and eyes are exposed to a hazard (e.g., during scraping scale), a full-face shield and goggles must be used. For those who wear corrective glasses, prescription safety glasses or goggles can be acquired through ABB Environmental Services, Inc. (ABB-ES). As a general safety precaution, eye protection meeting the requirements and specifications of American National Standards Institute (ANSI) Standard Z89.1-1981 Class B should be worn at all times while in the confined space.

I.5.2 Head Protection

Hard hats must be worn if working directly under the manhole or entryway, if there is any danger of items falling on the worker's head, or as an adjunct to face protection. All hard hats must meet the requirements and specifications of ANSI Standard 289.1-1968.

I.5.3 FOOT PROTECTION

Steel-toe, steel-shank, chemical-resistant boots (or boot covers) must be worn when entering a confined space if there is a danger of falling objects, stepping on a sharp object or nail, and/or chemical contaminants. All safety-toe footwear must meet the requirements and specifications of ANSI Standard 241.1-1967.

I.5.4 BODY PROTECTION

The level of dermal protection to be worn by all personnel entering the confined space will be determined by the HSO, based on all data available. In choosing the level of protection, the HSO must consider the chemical hazard present, as well as the potential for heat and cold stress.

I.5.5 HEARING PROTECTION

A hearing conservation program must be implemented if sound pressure levels equal or exceed 85 dBA (decibels on the A scale), based on an 8-hour, time-weighted average (TWA). Hearing protection is mandatory for noise levels above 90 dBA, and optional between 85 and 90 dBA. If noisy conditions are expected within the confined space, the HSO should notify the Health and Safety Manager (HSM) or the Health and Safety Supervisor (HSS) and make arrangements to have ear plugs at the site.

I.5.6 RESPIRATORY PROTECTION

The HSO will determine the level of respiratory protection, based on conditions and test results of the confined space and the work activity to be performed. (See Appendix G2 for selection guidelines.)

I.5.7 HAND PROTECTION

Gloves of impervious rubber or similar material are to be worn to protect against toxic or irritating materials. If rough surfaces or sharp edges are expected, canvas or metal mesh can be worn over the rubber gloves. Where isolation of the electrical system is

impossible, and current flow of more than 5 milliamperes through the body could potentially occur due to contact with energized electrical equipment, insulating gloves should be worn. These gloves must meet the requirements and specifications of ANSI Standard J6.6-1967.

I.5.8 Safety Belt/Harness

Non-entry rescue (e.g., retrieval systems) must be used whenever an authorized Entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Each Entrant shall use a chest or full body harness with a retrieval line attached at the center of the Entrants back near shoulder level or above the Entrants head. Wristlets may be used in lieu of the chest or full body harness if the ABB-ES can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative (e.g., opening is less than 18 inches in diameter). The other end of the retrieval line must be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device must be available to retrieve personnel from vertical type spaces of greater than 5 feet deep.

I.5.9 Other

When employees enter a confined space, a barricade must be erected if inadvertent entry poses a problem. The barricade must have a mechanism to prevent closure of the escapeway, signs warning of the danger present, a physical barrier (i.e., fence) to keep the area clear, and an adequate platform (a minimum size of 3 by 3 feet) for entry or exit. Added features such as a tripod with either block and tackle or a mechanical pulley mechanism should be used in situations where quick removal of a worker may be required. Communications equipment (i.e., intercom or radio systems) should be considered when the entry plan is formulated.

I.5.10 Equipment and Tools

Equipment and tools to be used in a confined space must be carefully inspected, and must meet the following requirements:

- Hand tools must be kept clean and in good repair.

- Portable electric tools, equipment, and lighting must be equipped with a ground fault circuit interrupter. All grounds must be checked before electrical equipment is used in a confined space.

- All electrical cords, tools, and equipment must be heavy duty, with heavy duty insulation, and inspected for visually detectable defects before use in a confined space. For use in a flammable atmosphere, their design must be explosion-proof and intrinsically safe.

- Air-driven power tools must be used when flammable liquids are present. The use of air-driven power tools will only reduce the risk of explosion, not eliminate it. Explosions can result from tools overheating (e.g., drilling), sparks produced by striking (e.g., percussion), grinding, or discharge of accumulated electrostatic charges developed from the flow of compressed air.

- Lighting used in Class A and Class B confined spaces must be explosion-proof and intrinsically safe and, where necessary, equipped with guards. Only equipment listed by the Underwriters Laboratories for use in Division 1, atmospheres of the appropriate class and group, or approved by U.S. Bureau of Mines, Mining Enforcement and Safety Administration, Mine Safety and Health Administration, or the U.S. Coast Guard should be used. Lighting should not be hung by electrical cords, unless specifically designed for that purpose. The illumination of the work area must be sufficient to provide for safe working conditions. Under no circumstances will matches or open flames be used in a confined space for illumination.

- Cylinders of compressed gas must never be taken into a confined space, and should be turned off at the cylinder valve when not in use. Exempt from this rule are cylinders that are part of self-contained breathing apparatus (SCBA) or resuscitation equipment.

- Ladders should be adequately secured, or of a permanent type that provides the same degree of safety.

- Scaffolding and staging must be properly designed to carry maximum expected load (safety factor of four), and be equipped with traction- type planking.

- Only hose lines and components specially designed for the compressed gas and working pressure should be used, and such systems must have a pressure relief valve outside the confined space.

I.6.0 TESTING AND MONITORING

Prior to entry into a confined space, workers must know its potential hazards. Deaths *have* occurred because a presumably safe space was not tested before initial entry. The OSHA Permit-Required Confined Space standard requires the following sequence of testing, in the order given, prior to entry into confined spaces:

1. Oxygen Content
2. Flammability
3. Toxic Chemicals

In addition to testing for chemical hazards, harmful physical agents (e.g., explosive dusts, noise, etc.) should also be conducted.

Specific instruments are required to test the atmosphere for these conditions. For example, combustible gas indicators are designed to measure the concentration of flammable gases, and will not measure or indicate the presence of carbon monoxide (CO) at toxic levels; conversely, a CO detector is designed to measure CO only. Combustible gas indicators respond differently to different flammable hydrocarbons; therefore, entry into confined spaces with flammable gas concentrations above 20 percent of the Lower Explosive Limit (LEL) should be avoided. The flammability measurement may be erroneous if the oxygen level is less than or greater than normal atmospheric concentrations. Therefore, it is required that the oxygen level be determined prior to flammability testing to make any necessary corrections in the flammability measurement.

The oxygen-deficiency measuring instrument is designed to measure the volume of oxygen present, usually scaled with a range of zero to 25 percent. If the oxygen level in a confined space atmosphere is less than 19.5 or greater than 23.5 percent, special precautions must be taken. In accordance with Occupational Safety and Health Administration (OSHA) Standard 29 CFR Part 1910 and other references, a minimum oxygen level of 19.5 percent has been adopted for worker safety. (This assumes that the 1.4 percent displaced oxygen was replaced with a nonhazardous substance.) The upper

oxygen limit has been set at 23.5 percent because an increase above this level will greatly increase the rate of combustion of flammable materials.

Continuous and/or frequent monitoring becomes necessary in cases where the work being performed within the confined space has the potential of generating toxic agents. Data collected for the National Institute for Occupational Safety and Health (NIOSH) show that in 28 of 80 accident events, the toxic gas or oxygen deficiency was not in the confined space at the time of entry, but was either generated by the work occurring in the space, or by gas being unexpectedly admitted into the confined space after the worker had entered. In these cases, only continuous and/or frequent monitoring would be a possible countermeasure.

I.7.0 ENTRY PERMIT

Before entry into a confined space is authorized, the HSO must document the completion of all required safety measures required by the OSHA Permit-Required Confined Space Standard. Documentation of these measures is done on the Confined Space Entry Permit (see Appendices G2 and G3). Entry into any confined space is by permit only unless first cleared by the HSM. The entry permit is an authorization and approval, in writing, that specifies the personnel permitted to enter the space and the location and type of work to be done. It certifies that all known hazards have been evaluated and necessary protective measures have been taken to ensure the safety of each worker. The entry permit will identify the permit space to be entered, the purpose of the entry, the date and authorized duration of the entry, the authorized entrants, the authorized attendants, the name and signature of the HSO, the hazards, measures used to isolate or eliminate the hazards, acceptable entry conditions, results of initial and periodic air monitoring, rescue and emergency procedures, communication procedures, equipment, as well as any other pertinent information or permits (e.g. for hot work) required.

At the site, the HSO acts as the Entry Supervisor and is responsible for the completion of the Confined Space Entry Permit and/or the Manhole/Sewer Entry Permit, ensuring that atmospheric testing has been conducted and all safety precautions have been addressed. The Permit will be posted at or near the entry portal so that all associates can confirm that pre-entry preparations have been completed. The entry permit applies only to the task or job identified and entry into the confined space cannot exceed the time required to complete the assigned task or job.

The HSO will terminate entry and cancel the entry permit when entry operations covered by the permit have been completed or a condition not allowed by the permit arises in or near the confined space. If problems are encountered during the entry operation, the HSO shall note it on the permit.

THE COMPLETED PERMIT MUST BE SENT TO THE HSM AS ABB-ES MUST RETAIN AND REVIEW EACH CANCELLED PERMIT ANNUALLY.

I.8.0 TRAINING/HEALTH MONITORING

ABB-ES personnel required to work in confined spaces, or in support of those working (if their duties include emergency rescue) in confined spaces, must be in the Health Monitoring Program and have received the 40-hours of initial hazardous waste site training, initial Confined Space Entry training, and site specific training. In addition, associates who act as Rescue personnel must maintain current certification in first aid and CPR and be trained in and have practiced rescue procedures immediately prior to entry.

As ABB-ES workers encounter a variety of confined spaces at a various locations, site specific training plays an important role in informing associates of the hazards associated with the entry. Site specific training shall be conducted prior to each entry, whenever there is a change in operations which an associate has not previously been trained, when there is a reason to believe that there are deviations from the permit space entry procedures, or inadequacies in the associate's knowledge or use of the procedures.

Training will include, but limited to, a review of the contents of the HASP and permit, verification of associate knowledge and/or training on the use all equipment to be used, emergency procedures, site specific hazards and the duties of their assigned role.

I.9.0 ROLES AND RESPONSIBILITIES

I.9.1 DUTIES OF AUTHORIZED ENTRANTS

The authorized entrants are the workers who actually enter the confined space and are therefore at the greatest risk. Because of this added degree of risk, these workers must be knowledgeable of the hazards they may be faced with during entry, including the mode, signs or symptoms, and consequences of the exposure and have the knowledge and

skills necessary to recognize a prohibited condition or dangerous situation. The Entrants must be made aware of and know the use of all the equipment they are required to use while in the confined space.

Communication is very important while workers are in a confined space. Entrants and Attendant must be in constant communication with each other to:

- Enable the Attendant to monitor the Entrants status
- To allow the Entrant to alert the Attendant whenever the Entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or when the Entrant detects a prohibited condition.
- To have the Entrant exit from the permit space as soon as possible whenever an order to evacuate is given by the Attendant or the HSO, when the Entrant recognizes any warning sign or symptom of exposure to a dangerous situation, when the Entrant detects a prohibited condition, or when an evacuation alarm is detected.

I.9.2 Duties of Attendants

The Attendant is responsible for ensuring the safety of the Entrants into a confined space and therefore must not perform any other duties that might interfere with the Attendants primary duty of monitoring and protecting the Entrants. The Attendant must be aware of the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure. The Attendants must be aware of the possible behavioral effects of the hazard exposure and continuously maintain an accurate count and identification of the authorized entrants in the space. The Attendant remains outside the permit space at all times during entry operations until he/she is relieved by another attendant. The Attendant must be in constant communication with the Entrants to monitor their status and to alert entrants of the need to evacuate the space. The Attendant monitors activities inside and outside the space to determine if it is safe to remain in the space and orders the Entrants to evacuate immediately under any of the following conditions:

- The Attendant detects a prohibited condition

- The Attendant detects the behavioral effects of a hazard exposure
- The Attendant detects a situation outside the space that could endanger the Entrants.
- The Attendant cannot effectively and safety perform all his/her duties.

The Attendant is responsible for summoning rescue and other emergency services as soon as the Attendant determines that the Entrants may need assistance and warns unauthorized persons that they must stay away or exit the space immediately should they approach or enter the confined space while entry is underway. Should unauthorized persons approach or enter the confined space, the Attendant must inform the HSO immediately.

The attendant is allowed to perform non-entry rescue only unless they meet the requirements to be on the Rescue Team and they are first relieved by another attendant.

I.9.3 Duties of Entry Supervisors (HSO)

The Entry Supervisor (HSO) has overall responsibility for the entry into the confined space. They are required to be knowledgeable of the hazards associated with the entry, including information on the mode, signs or symptoms, and consequences of exposure. The HSO is responsible for verifying, by checking, that the appropriate entries have been made on the permit, that all tests have been conducted, and that all procedures and equipment specified by the permit or in the HASP are in place before endorsing the permit and allowing entry. In addition, the HSO is responsible for terminating the entry and cancelling the permit whenever entry operations covered by the permit have been completed or if conditions not allowed under the entry permit arises in or near the space.

The HSO is required to ensure that all affected workers are properly trained and receive site specific training. The HSO is required to verify that the rescue services are available and the means for summoning them are operable. If ABB-ES rescue team is used, the HSO is responsible for ensuring that all Rescue team members have practiced rescues from the actual or a representative space prior to (within the last 12 months) authorizing entry into the confined space.

He/she is responsible for removing unauthorized individuals who enter or attempt to enter the confined space during entry operations. If the responsibility for a confined space is

transferred or at predetermined intervals based on the hazards and operations performed with in the space, he/she determines that entry operations remain consistent with the terms of the permit and that acceptable entry conditions are maintained.

I.9.4 Duties of Rescue and Emergency Services

Non-entry rescue (e.g., retrieval systems) must be used whenever an authorized Entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

The HSO must identify and verify that rescue and emergency services are available prior to allowing entry into a confined space. Rescue and emergency services personnel can be ABB-ES associates only if the following conditions are met.

Each member of the rescue team has received the following training:

- Proper use of personal protective equipment
- Proper use of rescue equipment necessary for making rescues from permit spaces
- Assigned Rescue duties
- Duties of the authorized Entrants.
- First aid
- CPR

The Rescue team must practice making confined space rescues at least once every 12 months from the actual or a representative confined space. A representative space is one in which the opening size, configuration, and accessibility is similar to the actual confined space. As it will be difficult to anticipate the types of spaces that ABB-ES associates encounter, the practice rescue will more than likely have to take place immediately prior to entry using the actual confined space. When simulating rescue operations, workers must practice removing dummies, manikins, or actual persons from the confined space (or a representative space).

If an outside service is to be used for rescue, the HSO must inform the rescue service of the hazards involved with entry into the space, and provide access to all the confined space(s) so that they can develop appropriate rescue plans and practice rescue operations.

I.10.0 RESCUE PROCEDURES

Rescue procedures to be used are site specific and will be developed as part of the HASP.

I.11.0 HOST EMPLOYER/CONTRACTOR/SUBCONTRACTOR

When confined space entry procedures are done in conjunction with another company (host employer/contractor/subcontractor), the entry will be coordinated to ensure that is done is a safe manner for all concerned. If the host employer or Contractor has existing confined space entry procedures, ABB-ES will attempt to obtain and review these procedures as well as all available information regarding the space and the hazards associated with it. If the host employer's/contractor's procedures meet ABB-ES minimum safety procedures, those precautions and procedures will be used. If ABB-ES feels that more stringent entry procedures are warranted, they will notify the host employer of the methods they will use when entering the confined space.

If ABB-ES is the General Contractor at the site, they will notify the subcontractor of the existence of permit-required confined spaces and that entry is allowed only through compliance with an Confined Space Entry Program. ABB-ES will notify the subcontractor of the hazards, precautions, and procedures ABB-ES has implemented for working in or near the space.
All entries will be coordinated with the host employer, contractor, or subcontractor personnel as required. ABB-ES will debrief the subcontractor or inform the host employer/contractor at the conclusion of the entry operations of any hazards confronted or created in the confined space.

I.12.0 REVIEW OF PERMIT-REQUIRED CONFINED SPACE PROGRAM

The HSM will review the Permit-Required Confined Spaces program on an annual basis or whenever there is reason to believe that measures taken under the program may not protect ABB-ES associates. The HSM will review the Program using the completed permits as well as all other available information as a guide. Based on the findings, the HSM will revise the Program, as appropriate to correct deficiencies to ensure that associates are protected from permit space hazards. No associate will be allowed to enter a confined space until all deficiencies are corrected.

I.13.0 GENERAL ENTRY PROCEDURES

This subsection describes general entry procedures for confined spaces. The actual procedures used on a site may vary, depending on site conditions and the hazards associated with the confined space.

I.13.1 TEAM SIZE

A minimum of two workers are required for each confined space activity, one Entrant and One Attendant/Entry Supervisor (HSO). This is for a relatively non-hazardous space where a non-entry retrieval system is being used. Arrangements for a rescue team must still be done, however, they do not have to present during the entry. Additional personnel will be needed for larger, hazardous, more complex entries, especially where there is a possibility that a rescue team may need to enter the space to rescue the Entrant. In these circumstances, a minimum of four workers are required, one Entrant, one Attendant, one HSO, and one Rescue.

These are the minimum numbers required, in most cases. Additional crew members may be needed if entering a Class A or Class B confined spaces, or specialty tasks must be completed. Additional crew could include additional Entrants, decontamination personnel, etc.

I.13.2 GENERAL ENTRY PROCEDURES

The following steps must be taken when entering a confined space:

(1) Check and calibrate all pieces of equipment to ensure they are in good working order. DO NOT ENTER A CONFINED SPACE WITH DEFECTIVE EQUIPMENT!

(2) Conduct a background check to identify all potential hazards that may be encountered in the confined space. Determine if there is a potential for fire/explosion hazards, as well as a toxic or oxygen-deficient atmosphere.

(3) Define and demarcate the exclusion zone with flagging or some other method. Ensure that the entrance into the confined space remains locked, blocked, or otherwise protected until workers are ready to enter the space. If the entrance cannot be protected from unauthorized entry, place a sign one or near the entry stating **DANGER - PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER.**

(3) Before entry, test the atmosphere inside the confined space. An attempt should be made to test the atmosphere without opening the entryway (i.e., through a vent line or a small opening). If the entryway must be opened to test and only low levels are expected in the confined space, crack open the entryway, test the breathing zone first, and then test the confined space. If potentially high levels are expected in the breathing zone, respiratory protection should be worn while opening the entryway cover.

(4) If an oxygen deficient, explosive, or toxic atmosphere is detected, purge or ventilate the confined space before entry. Retest the atmosphere three times at 5-minute intervals. A person can enter the confined space without respiratory protection only if all three test results are below the PEL/TLV, 10 percent of the LEL, and above 19.5 percent oxygen (all three conditions *must* be met). (NOTE: Any downward deflection of the readings on the oxygen meter from background [i.e., 20.9 percent] should be viewed as a potential for an IDLH atmosphere. Unless contaminants are known to be nontoxic, do not enter the confined space without respiratory protection if the oxygen level is below background.

(5) Blank, block, or otherwise isolate, lock-out, and tag all chemical, physical, and/or electrical hazards, wherever possible.

(6) If Entrants are using an air-purifying respirator or if an IDLH and/or explosive atmosphere exists, air monitoring must be on a continuous basis. If respiratory protection is not used and there is potential for atmospheric conditions to change due to work practices or conditions, air monitoring should be done continuously or periodically as site conditions warrant. In all these cases, a 5-minute escape pack must be used.

(7) Record all results of the tests for hazardous conditions, including the location, time, date, weather (if applicable), and readings on the photoionization detector

(PID), combustible gas meter, oxygen-deficiency meter, Draeger tubes, and any other equipment used on the Confined Space Entry Permit.

(8) Wear appropriate clothing for site conditions, as determined by the HSO.

(9) Wear a safety belt or harness with lifeline when entering a confined space unless their use is not feasible or is a safety hazard. If the diameter of the entryway is less than 18 inches, the wrist-type harness must be use, and special provisions made if a supplied-air respirator is necessary.

(10) The HSO must check to ensure that the Confined Space Entry Permit is completed and all associates are adequately trained before authorizing entry.

(11) One person (Attendant) must remain at the entryway at all times and must maintain continuous contact with the person entering the confined space. Contact can be maintained by line of sight, listening for sounds, the safety line, and/or radio. The Attendant must not enter the confined space unless the non-entry retrieval is inoperable or infeasible, they are a trained rescuer, another trained person is available to act as an Attendant, and he/she is equipped with adequate respiratory and dermal protection. (In most cases, respiratory protection would be an airline respirator or SCBA.)

(12) Do not smoke when working in or near confined spaces, and do not take flash-lit photographs when explosive gases are known or suspected to be present.

(13) Do not rely on permanent ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect permanent ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable ladder of adequate height to reach 3 feet above opening, or a rope ladder, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off, if possible; otherwise, it should be held in place by the standby person.

(14) Do not work without adequate lighting. Use only explosion-proof lights or hand lamps.

(15) The entry person must not remain in the confined space if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Many gases that cause the most problems are odorless, tasteless, and invisible.

(16) THE HSO MUST CANCEL THE PERMIT, NOTE AND PROBLEMS ENCOUNTERED AND SEND COMPLETED FORM TO THE HSM IN PORTLAND MAINE.

I.13.3 MANHOLE/SEWER ENTRY

When preparing to enter a manhole/sewer, the following safety measures must be taken.

(1) Check all pieces of equipment to ensure they are in good working order. DO NOT ENTER THE MANHOLE WITH DEFECTIVE EQUIPMENT!

(2) Park the vehicle near the manhole (DO NOT leave the vehicle running). If the manhole is in the street, it is best to park so as to detour oncoming traffic around the manhole. The vehicle's emergency flashers and portable yellow warning beacon must be ON. The vehicle serves as protection from oncoming traffic, can be used to store emergency equipment (e.g., SCBA and first-aid kit), and can be used in extreme emergency to slowly pull an injured person from the confined space if a tripod with hoist attachment is unavailable or inoperable.

(3) When appropriate, erect portable barricades or cones around the manhole and in front of the vehicle to adequately divert traffic and to prevent pedestrians from falling in. Reflective vests should be worn so that workers are visible to approaching traffic.

(4) If there are openings large enough to admit sampling tubes, test for the presence of explosive and toxic gases before removing each manhole cover. Otherwise, raise one side of the cover using the cover hook or pick, prop it slightly open, and conduct the tests.

(5) If toxic or explosive gases are detected in the sewer that could be indicative of a spill, leak, or otherwise hazardous condition, report this immediately to the local fire department and/or department of public works.

(6) On the Manhole/Sewer Entry Permit, record the results of tests for hazardous conditions, including location, manhole number (if applicable), time, date, weather (if applicable), and readings on the PID, combustible gas meter, oxygen-deficiency meter, and Draeger tube. Once the Manhole/Sewer Entry Permit is completed, the HSO will verify all information before authorizing entry.

(7) Remove manhole covers with a cover hook or pick; do not improvise. Be careful of fingers and toes; the cover is usually heavy and difficult to handle. Unless the cover is extremely heavy, it is safer for only one worker to handle it.

(8) Test the atmosphere; if a toxic, flammable, or oxygen-deficient atmosphere exists, ventilate the sewer. Depending on the hazard, ventilation can be accomplished in several ways; for example: (1) remove and vent the adjoining upstream and downstream manhole covers, as soon as possible, and well in advance of entering the manhole (high hazard); and (2) vent the manhole in which entry will occur (very low hazard). If a blower is used, it is desirable to establish a flow of air in the sewer; that is, in one manhole and out another. Ensure that the air intake is well away from automobile exhaust, and combustible and/or toxic atmospheres. Appropriate traffic control measures must be taken by barricading or otherwise marking the open manholes.

(9) After ventilating, test for explosive and toxic gases and oxygen deficiency in the manhole at ground level and at the bottom; record the results. If entering the sewer itself, perform the same tests at the manholes at either end. If ventilation is necessary, monitor the atmosphere in the manhole while work progresses, or continue operation of the blower. Continuous monitoring (i.e., equipment ON during entire entry) is imperative because conditions within the sewer may change rapidly. Do not enter a manhole while there is an oxygen deficiency without a pressure-demand, air-supplied breathing apparatus. If the oxygen level is lower than 20.9 percent of background, caution must be taken because an IDLH atmosphere may exist.

(10) When entering manholes or tanks, wear hard hats, protective clothing, and appropriate respiratory protection and safety belt or harness with lifeline (when appropriate). If the manhole is less than 18 inches in diameter, a wrist-type harness must be used and special provisions made if air-supplied respirators are necessary. When working in manholes deeper than 12 feet, in the sewer itself, or where potential exists for gases to appear unexpectedly, a 5-minute emergency

egress air supply is required (unless the time required to don the emergency respirator is greater than what would be needed to exit the manhole).

(11) At least one person (i.e., standby) must remain at the manhole at all times and must maintain continuous contact with the person entering the sewer. Contact can be maintained by line of sight, listening for prearranged sounds, and the safety line signals and/or radio. The standby person must not enter the manhole unless another trained person is available to act as standby and has adequate respiratory and dermal protection available. (In most cases, respiratory protection will be an airline respirator or SCBA.) The standby/rescue person should be suited up (but not yet on air) before the work crew enters the confined space.

(12) Do not smoke when working in or near manholes. Do not take flash-lit photographs when explosive gases are known or suspected to be present.

(13) Do not rely on the manhole ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect manhole ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable or rope ladder of adequate height to reach 3 feet above the manhole opening, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off if possible; otherwise, it should be held in place by the standby person.

(14) Do not work without adequate lighting. Use only explosion-proof lights or hand lamps in the manhole or sewer.

(15) The entry person must not remain in the manhole or sewer if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Remember that CO, carbon dioxide, methane, and hydrogen sulfide, which cause the most trouble, are odorless (e.g., hydrogen sulfide has a distinct odor only during initial exposure), tasteless, and invisible gases.

(16) Once the permitted work is completed, the HSO will cancel the permit, note any problems, and send it to the HSM in Portland Maine.

DEFINITIONS AND ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
ANSI	American National Standards Institute
Atmosphere	Refers to the gases, vapors, mists, fumes, and dusts within a confined space.
Attendant	The individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program
Blanking/Blocking	The absolute closure of a pipe, line, or duct by fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
Ceiling Level	The maximum airborne concentration of a toxic agent to which an employee may be exposed for a specified period of time.
CO	carbon monoxide
Combustible Dust	A dust capable of undergoing combustion or burning when subjected to a source of ignition.
Confined Space	A space that is large enough and so configured that an associate can bodily enter and perform assigned work; has limited or restricted means for entry or exit; and is not designed for continuous use. Confined spaces include, but are not limited to, storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.

Confined Space, Class "A"	A confined space that presents situations that are IDLH. These include, but are not limited to, oxygen deficiency, explosive or flammable atmospheres, and/or concentrations of toxic substances.
Confined Space, Class "B"	A confined space that has the potential for causing injury and illness, if preventive measures are not used, but not IDLH.
Confined Space, Class "C"	A confined space in which the potential hazard would not require any special modification of the work procedure.
CPR	Cardiopulmonary Resuscitation
Double Block and Bleed	The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
Engulfment	The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.
Entry	The action by which a person passes through an opening into a permit-required confined space. Entry includes ensuring work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.
Entry Supervisor	The person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by

	1910.146. (Note: the Entry Supervisor may also serve as the attendant or as an authorized entrant as long as that person is trained and equipped as required for each role he/she/fills.)
HASP	Health and Safety Plan
HSO	Health and Safety Officer
HSM	Health and Safety Manager
HSS	Health and Safety Supervisor
Hot Work	Any work involving burning, welding, riveting, or similar fire-producing operations, as well as work that produces a source of ignition (e.g., drilling, abrasive blasting, and space heating).
IDLH	Immediately Dangerous to Life and Health
Inerting	Displacement of the atmosphere by a nonreactive gas (e.g., nitrogen) to such an extent that the resulting atmosphere is noncombustible.
Isolation	A process whereby the confined space is removed from service and completely protected against the inadvertent release of material by the following: blanking off (skillet type metal blank between flanges), misaligning sections of all lines and pipes, a double block and bleed system, electrical lock-out of all sources of power, and blocking or disconnecting all mechanical linkages.
Lower Explosive Limit	The minimum concentration of a combustible gas or vapor.
(LEL)	in air (usually expressed in percentage by volume at sea level), which will ignite if any ignition source (sufficient ignition energy) is present.

NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
Oxygen Deficiency	Refers to an atmosphere with a partial pressure of oxygen (PO_2) less than 132- mm Hg. Normal air at sea level contains approximately 21 percent oxygen at a PO_2 of 160-mm Hg. At an altitude of 5,280 feet, normal air contains approximately 21 percent 0_2 at a PO_2 of 132-mm Hg.
Oxygen-enriched Atmosphere	Any oxygen concentration greater than 23.5 percent (PO_2 190-mm Hg) at normal atmospheric pressure.
Permissible Exposure Limit (PEL)	The maximum 8-hour, TWA of any airborne contaminant which an employee may be exposed. At no time shall the exposure level exceed the ceiling concentration for that contaminant, as listed in 29 CFR Part 1910 Subpart Z.
Permit-Required Confined Space	A confined space that has one or more of the following characteristics: 1) contains or has a potential to contain a hazardous atmosphere; 2) contains a material that has the potential for engulfing an entrant; 3) has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or 4) contains any other recognized serious safety or health hazard.
PID	Photoionization Detector
ppm	parts per million
Prohibited Condition	Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.
psi	pounds per square inch

Purging	The method by which gases, vapors, or other airborne impurities are displaced from a confined space.
Respirator (Approved)	A device that has met the requirements of 30 CFR Part 11, is designed to protect the wearer from inhalation of harmful atmospheres, and has been approved by the Bureau of Mines and NIOSH, and the Mine Safety and Health Administration (formerly, Mining Enforcement and Safety Administration).
SCBA	self-contained breathing apparatus
Standby Person	A person trained in emergency rescue procedures, assigned to remain outside the confined space and to be in communication with those working inside.
Threshold Limit Value (TLV)	The maximum 8-hour, TWA of any airborne contaminant to which an employee may be exposed as recommended by the American Conference of Governmental Industrial Hygienists.
TWA	time-weighted average

CONFINED SPACE ENTRY PERMIT

CONFINED SPACE ENTRY PERMIT
29 CFR 1910.146

Site Name:_____ Site Location:_____
Purpose of Entry:_____
Contaminants:_____
Type of Confined Space:_____
Date and Time of Entry:_____ Date and Time Permit Expires_____

POTENTIAL HAZARDS: (Check all that apply)

☐ Flammable	☐ Moving Parts	☐ Radioactive	☐ Entrapment
☐ O_2 Deficiency	☐ Valves & Pipes	☐ Noise	☐ Engulfment
☐ Toxic	☐ Electrical	☐ Heat	☐ Other _____

EQUIPMENT REQUIRED: (Check all that apply)

[X] LEL/O_2 Meter	[X] Safety Harness	☐ Level A	[X] Stand by SCBA
☐ PID	[X] Lifeline	☐ Level B	☐ Ladder
☐ FID	☐ Hoist	☐ Level C	☐ Barrier and shield
☐ Draeger Tubes	☐ Ventilation	☐ Mod. Level D	☐ Radio
☐ Hydrogen Sulfide	☐ Lighting	☐ Level D	☐ Cellular Telephone
☐ Other:_____			

ACCEPTABLE ATMOSPHERIC LEVELS FOR ENTRY:

>19.5%	= Oxygen	_____	= PID/FID
<10%*	= LEL	_____	= Draeger Tube _____
<10%	= Hydrogen Sulfide Meter	_____	= Other _____

*May use <20% LEL as long as precautions are taken (e.g., non–sparking tools, intrinsically safe equipment)

ATMOSPHERE TESTING RESULTS:

Record time and results of readings at Entryway (prior to opening door or cover), Initial atmosphere (greatest of top, middle or bottom of space), when atmosphere Stabilizes after ventilation (greatest of top, middle, or bottom of space), and periodically thereafter in the workers Breathing Zone.

	Entryway	Initial*	Stabilized	Breathing Zone	Breathing Zone	Breathing Zone	Breathing Zone
Time							
% Oxygen							
% LEL							
H_2S Meter (ppm)							
PID/FID (ppm)							
Draeger Tube (ppm) Tube:							
Other (list)							

*If initial readings are acceptable, workers can enter space in Level D or Modified Level D withhout ventilation.

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Yes	No	N/A	
			All identified atmospheric and physical hazards are controlled.
			All hazards introduced by the work performed are addressed (e.g., welding fumes).
			Air intake of the ventilation system is located in an area free of contaminants.
			Valves, pipes, and mechanical and electrical equipment has been locked–out, blocked chocked, disengaged or otherwise disconnected where necessary.
			All required equipment and rescue equipment is present and in good working condition.
			Non–sparking tools and intrinsically safe equipment and lighting are used if required.
			All monitoring instruments have been properly calibrated.
			All workers have initial confined space entry training certification.
			All workers receive site specific confined space entry training.
			Rescue team members practiced rescue operations in space or similar space.
			Practice Date:_____
			All rescue team members certified in first aid and CPR.
			Entry coordinated with subcontractors.

DESCRIPTION OF RESCUE PROCEDURES:

PROBLEMS ENCOUNTERED: Was rescue required?____

SIGNATURES:

I have reviewed the work authorized by this permit and the information contained here–in. Written instructions and safety procedures have been received and understood. I understand that this permit is not valid and the permit cannot be approved and entry conducted if any of the above squares are marked "NO" or if required sections are incomplete.

Entrants: _____ _____
Attendants: _____ _____
Rescue Team: _____ _____
Other: _____ _____

Permit prepared by: _____

Entry Authorized by (HSO): (Print)_____ (Signature)_____

PERMIT CANCELLATION:

Reason: _____

HSO Signature: _____

☐ Copy of form sent to Health and Safety Manager, Portland, ME. (manditory)

MANHOLE/SEWER ENTRY PERMIT

MANHOLE/SEWER ENTRY PERMIT
29 CFR 1910.146

Site Name:_____ Site Location:_____

Purpose of Entry:_____ Date and Time of Entry:_____

ACCEPTABLE ATMOSPHERIC LEVELS FOR ENTRY:

≥19.5%	= Oxygen	_____	= PID/FID
<10%*	= LEL	_____	= Draeger Tube _____
<10%	= Hydrogen Sulfide Meter	_____	= Other _____

*May use <20% LEL as long as precautions are taken (e.g., non-sparking tools, intrinsically safe equipment)

EQUIPMENT REQUIRED: (Check all that apply)

X	LEL/O_2 Meter	X	Safety Harness		Level A	X	Stand by SCBA
	PID	X	Lifeline		Level B		Ladder
	FID	X	Hoist		Level C		Barrier and shield
	Draeger Tubes		Ventilation		Mod. Level D		Radio
	Hydrogen Sulfide		Lighting		Level D		Cellular Telephone
	Other:_____						

ATMOSPHERE TESTING RESULTS:

Record time and results of readings at Entryway (prior to opening door or cover), Initial atmosphere (greatest of top, middle or bottom of space), when atmosphere Stabilizes after ventilation (greatest of top, middle, and space), and periodically thereafter in the workers Breathing Zone.

	Entryway	Initial*	Stabilized	Breathing Zone	Breathing Zone	Breathing Zone	Breathing Zone
Time							
% Oxygen							
% LEL							
H_2S Meter (ppm)							
PID/FID (ppm)							
Draeger Tube (ppm)							
Other (list)							

*If initial readings are acceptable, workers can enter space in Level D or Modified Level D withhout ventilation.

DESCRIPTION OF RESCUE PROCEDURES:

Full chest of body harness with retrieval line connected in the center of back at shoulder level or above entrants head. Retrieval line will be connected to tripod with hoisting device. Non-entry retrieval will be conducted. If entry for rescue is required, workers will don Level B PPE.

MANHOLE/SEWER ENTRY PERMIT
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Yes	No	N/A	
			All identified atmospheric and physical hazards are controlled.
			All hazards introduced by the work performed are addressed (e.g., welding fumes).
			Air intake of the ventilation system is located in an area free of contaminants.
			All required equipment and rescue equipment is present and in good working condition.
			Non–sparking tools and intrinsically safe equipment and lighting are used if required.
			All monitoring instruments have been properly calibrated.
			All workers have initial confined space entry training certification.
			All workers received site specific confined space entry training.
			Rescue team members practiced rescue operations in space or similar space.
			Practice Date:_____
			All rescue team members certified in first aid and CPR.
			Entry coordinated with subcontractors.

PROBLEMS ENCOUNTERED:

Was rescue required?____

SIGNATURES:

I have reviewed the work authorized by this permit and the information contained here–in. Written instructions and safety procedures have been received and understood. I understand that this permit is not valid and the permit cannot be approved and entry conducted if any of the above squares are marked "NO" or if required sections are incomplete.

Entrants: _____ _____
Attendants: _____ _____
Rescue Team: _____ _____
Other: _____ _____

Permit prepared by: _____
Entry Authorized by (HSO): (Print)_____ (Signature)_____

PERMIT CANCELLATION:

Reason: _____

HSO Signature: _____

☐ Copy of form sent to Health and Safety Manager, Portland, ME. (manditory)

EXCAVATION AND TRENCHING

J.1 EXCAVATION PROCEDURES

Because excavations and trenches pose a hazard to employees, structures, and equipment, all excavations created during site operations will be done in accordance with 29 CFR 1926 Subpart P. The following steps summarize the excavation procedures that will be followed by all ABB Environmental personnel:

- Prior to excavating or trenching, all surface encumbrances located so as to create a hazard to the employees will be removed or supported, and all underground utilities will be determined and located.
- Entry into excavations will be avoided at all costs. If entry is unavoidable, the excavation will be considered a confined space; as such, entry will be done in accordance with the Confined Space Entry Program (see Appendix I).
- Under no circumstances will site personnel enter excavations that are not adequately protected from cave-ins by shoring or sloping.
- Stairways, ladders, or ramps will be located in trenches deeper than 4 feet and situated to require no more than 25 feet of lateral travel.
- Excavations below the base of a building or structure will not be permitted unless the building or structure is adequately supported or a registered professional engineer determines that the excavation will not pose a hazard to the employee.
- All equipment will be kept at least 2 feet from the edge of the excavation.
- Any excavation left open and unattended will be barricaded or covered until it can be backfilled.

J.2 SLOPING

Acceptable options for sloping or benching include the following:

Option 1. A slope of 1½ horizontal to 1 vertical (34 degrees measured from the horizontal).

Option 2. Determination of the maximum allowable slope based on soil conditions and in accordance with the conditions and requirements set forth in 1926 Subpart P, Appendices A and B (see Attachment A).

Option 3. Designs of sloping or benching systems using tabulated data approved by a registered professional engineer.

Option 4. Other systems designed by a registered professional engineer.

J.3 SHORING

Acceptable options for shoring include the following:

Option 1. Designs using Appendices A, C, and D of 1910.126 Subpart P (see Attachment A).

Option 2. Designs using manufacturers tabulated data.

Option 3. Designs using tabulated data approved by a registered professional engineer.

Option 4. Other support systems designed by a registered professional engineer.

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OCCUPATIONAL SAFETY AND HEALTH STANDARDS - EXCAVATIONS

(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

(g) *Shield systems*—(1) *General.* (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

Appendix A to Subpart P

Soil Classification

(a) *Scope and application*—(1) *Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in § 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in § 1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for Testing Materials (ASTM) Standards D653–85 and D2488; The Unified Soils Classification System, The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS–121.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Soil classification system means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil means soil which is underwater or is free seeping.

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or

(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(iii) The soil has been previously disturbed; or

(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or

(ii) Granular soils including gravel, sand, and loamy sand; or

(iii) Submerged soil or soil from which water is freely seeping; or

(iv) Submerged rock that is not stable, or

(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) *Requirements*—(1) *Classification of soil and rock deposits.* Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) *Basis of classification.* The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses

shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) *Visual and manual analyses.* The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) *Layered systems.* In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) *Reclassification.* If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) *Acceptable visual and manual tests.*—(1) *Visual tests.* Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) *Manual tests.* Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) *Plasticity.* Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as ⅛-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of ⅛-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) *Dry strength.* If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488—"Standard Recommended Practice for Description of Soils (Visual—Manual Procedure)."): Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as a unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

Appendix B to Subpart P

Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in § 1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and ravelling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements.*—(1) *Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B-1 of this appendix.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least ½ horizontal to one vertical (½H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with § 1926.651(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B-1.

TABLE B-1

MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK	VERTICAL (90°)
TYPE A [2]	3/4 : 1 (53°)
TYPE B	1:1 (45°)
TYPE C	1½: 1 (34°)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

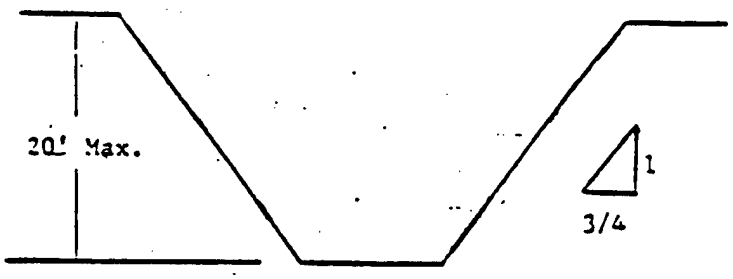
Figure B-.

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

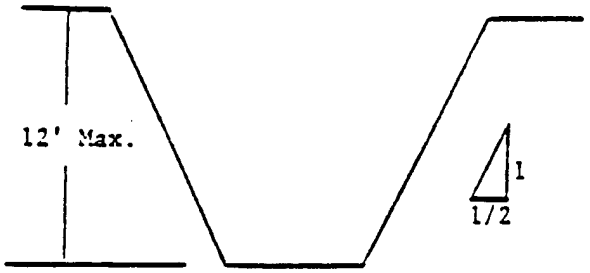
B-1.1 Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



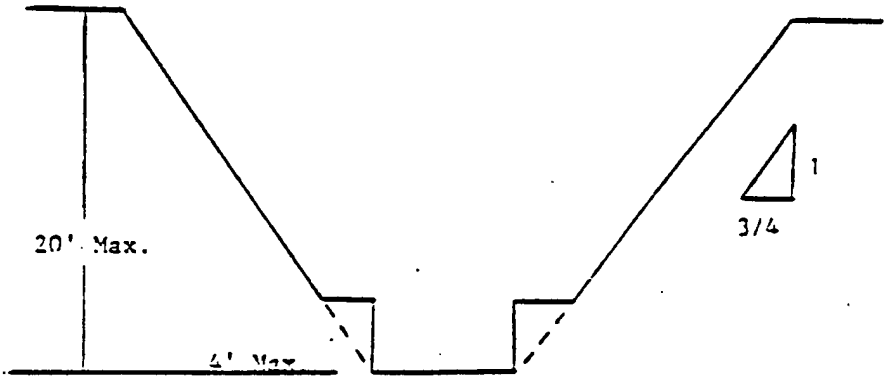
Simple Slope—General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ½:1.

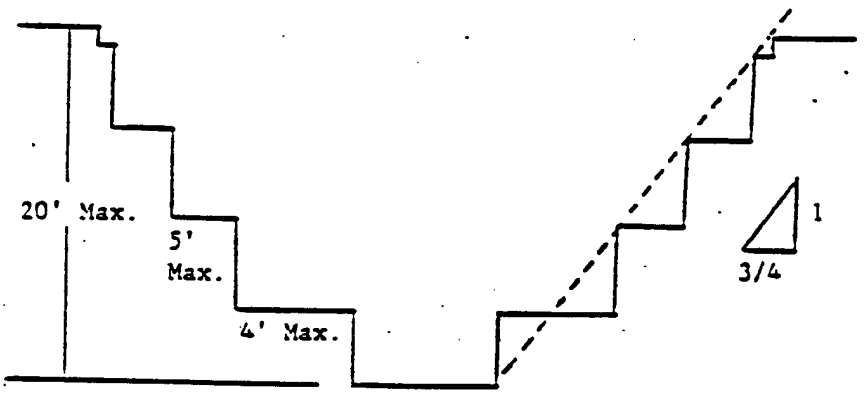


Simple Slope—Short Term

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of ¾ to 1 and maximum bench dimensions as follows:

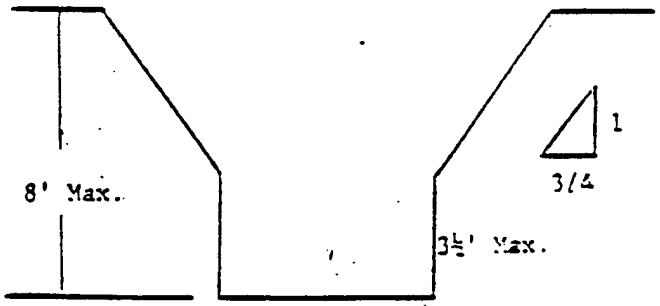


Simple Bench



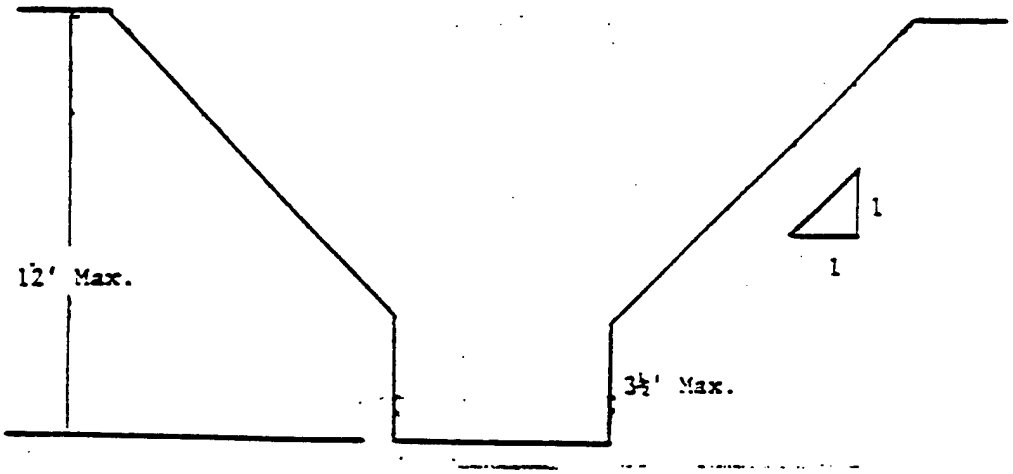
Multiple Bench

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.



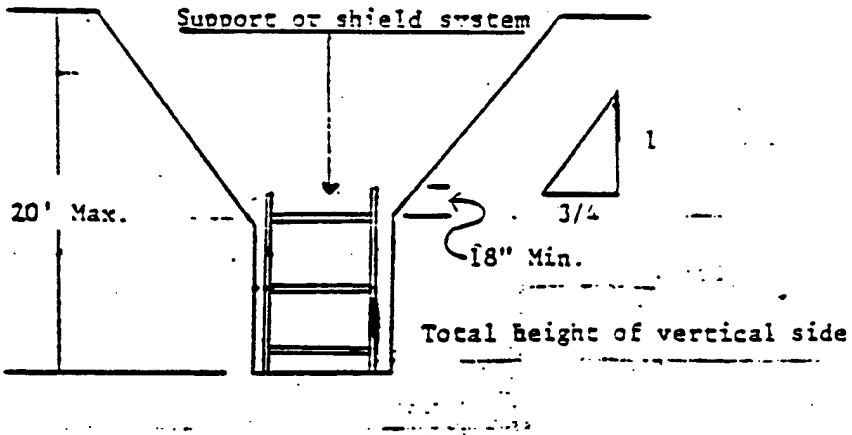
Unsupported Vertically Sided Lower Portion—Maximum 8 Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet.



Unsupported Vertically Sided Lower Portion—Maximum 12 Feet in Depth

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of ¾:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

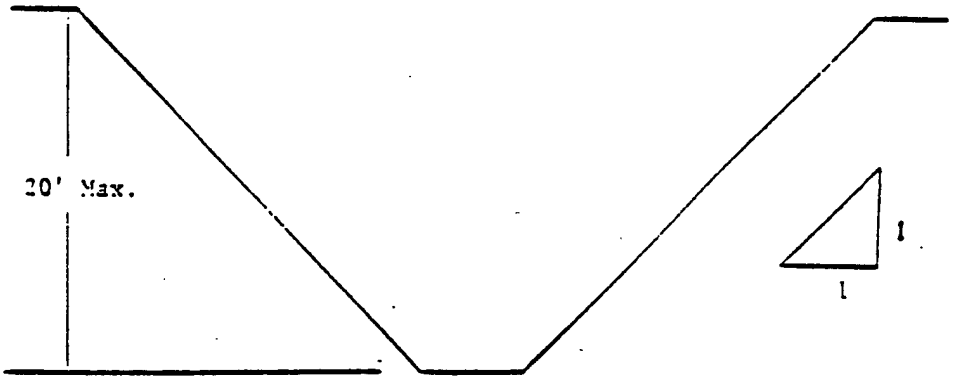


Suported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under § 1926.652(b).

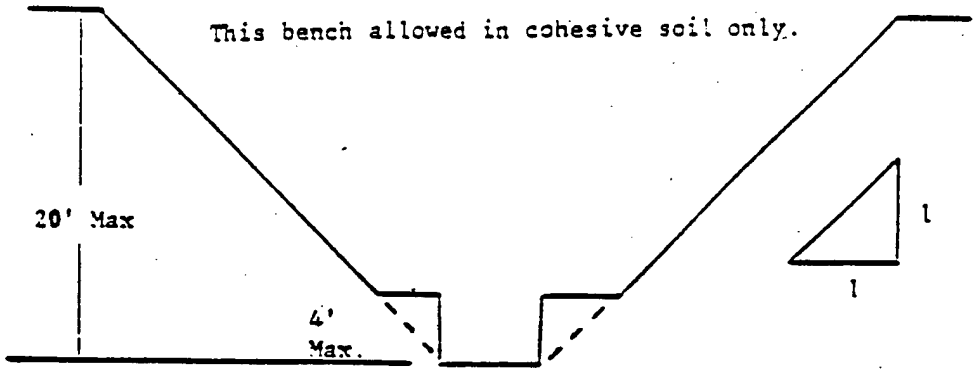
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

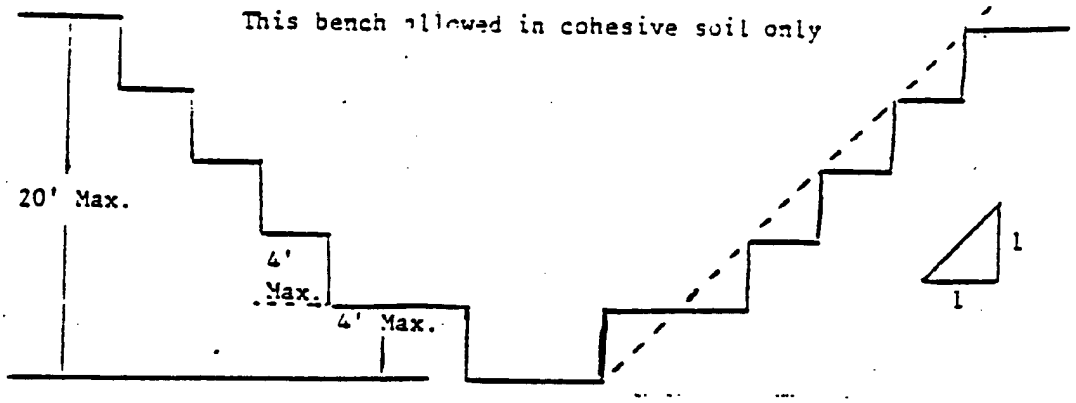


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

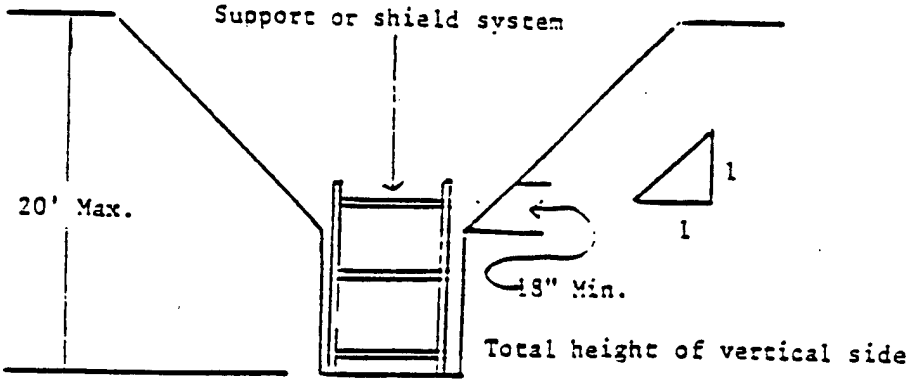


Single Bench



Multiple Bench

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

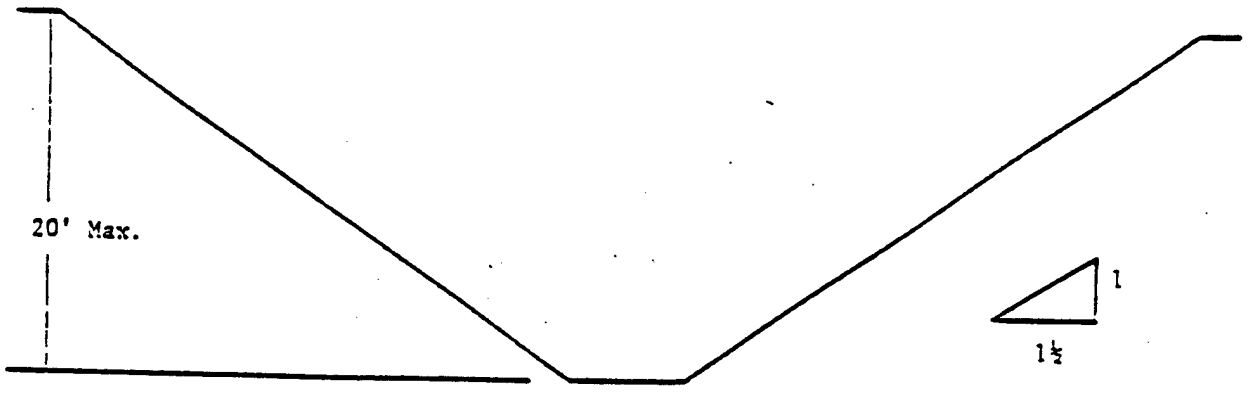


Vertically Sided Lower Portion

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

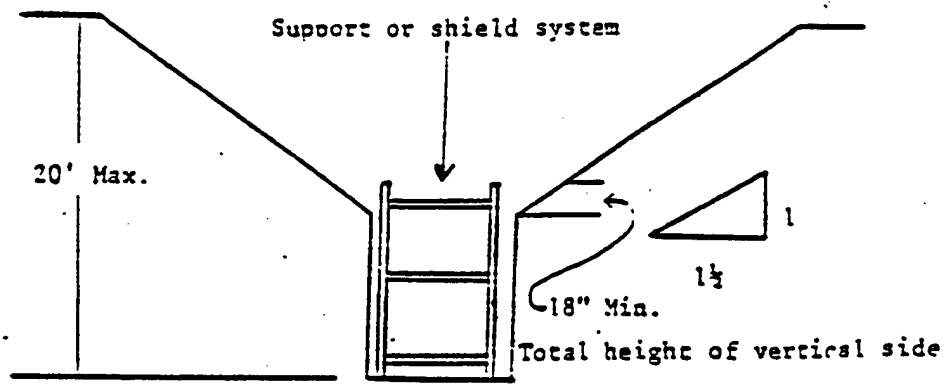
B–1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.

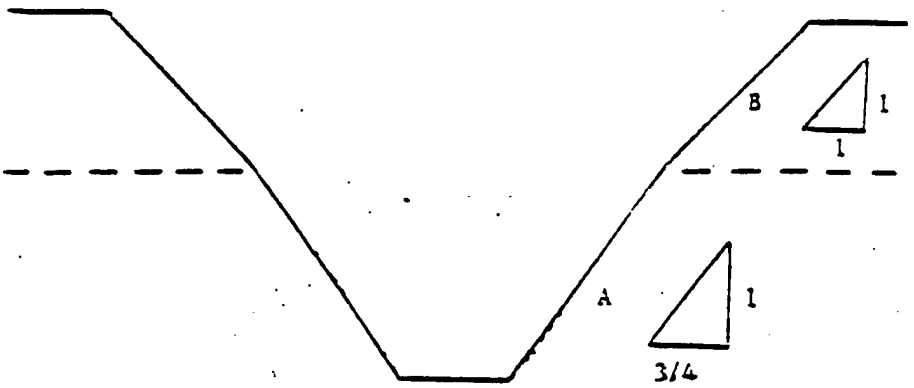


Vertical Sided Lower Portion

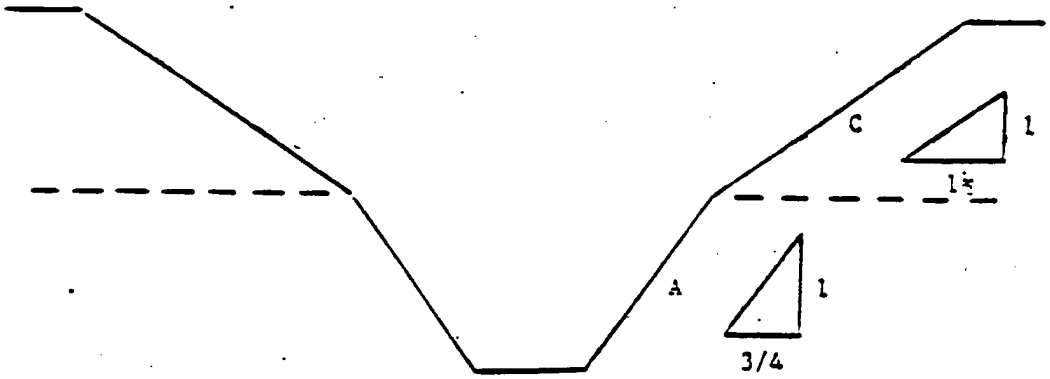
3. Al. other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

B–1.4 Excavations Made in Layered Soils

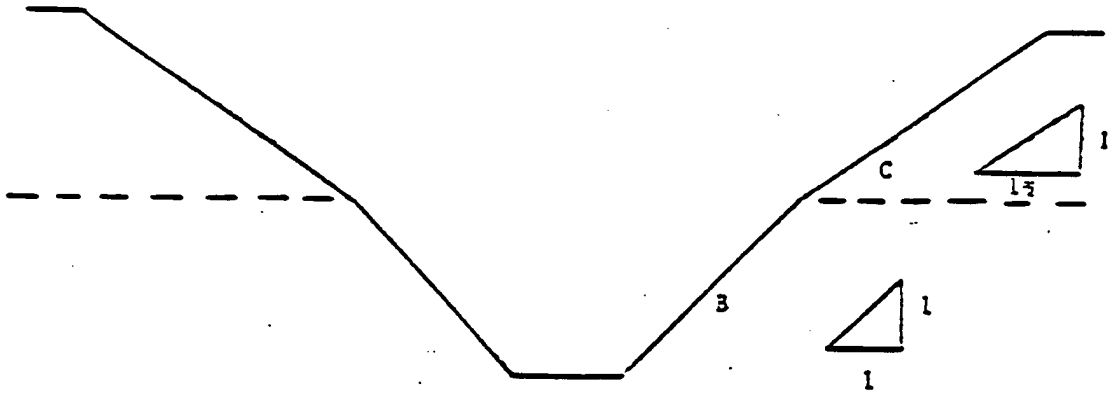
1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.



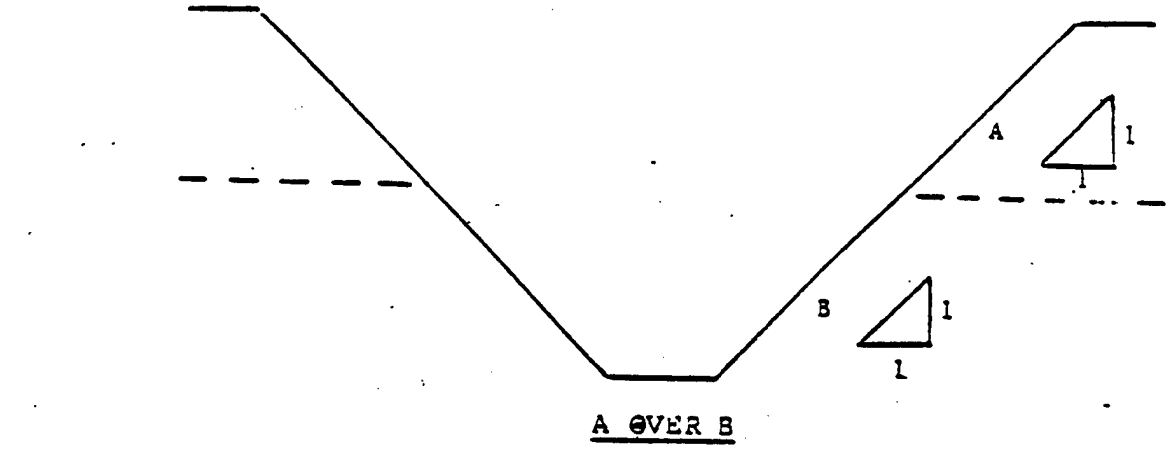
B OVER A



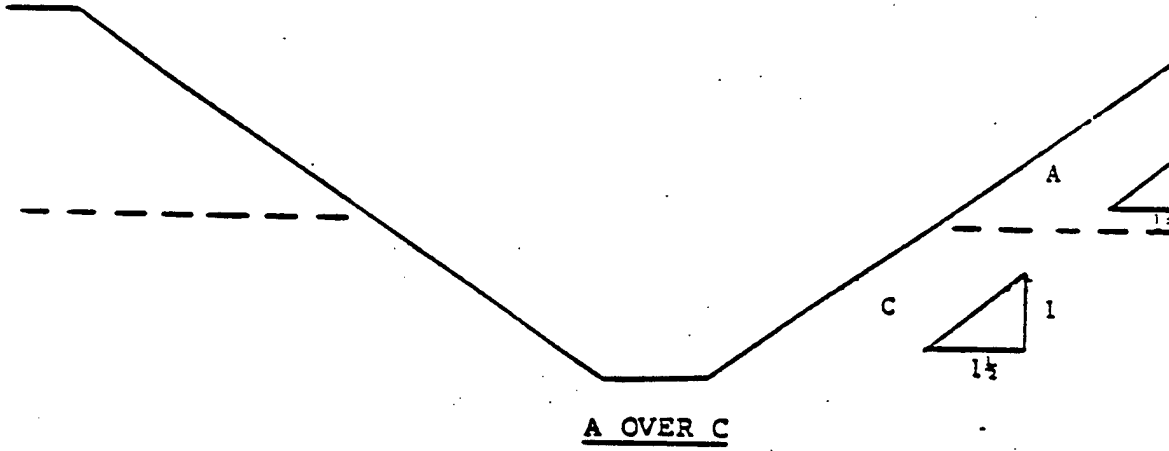
C OVER A



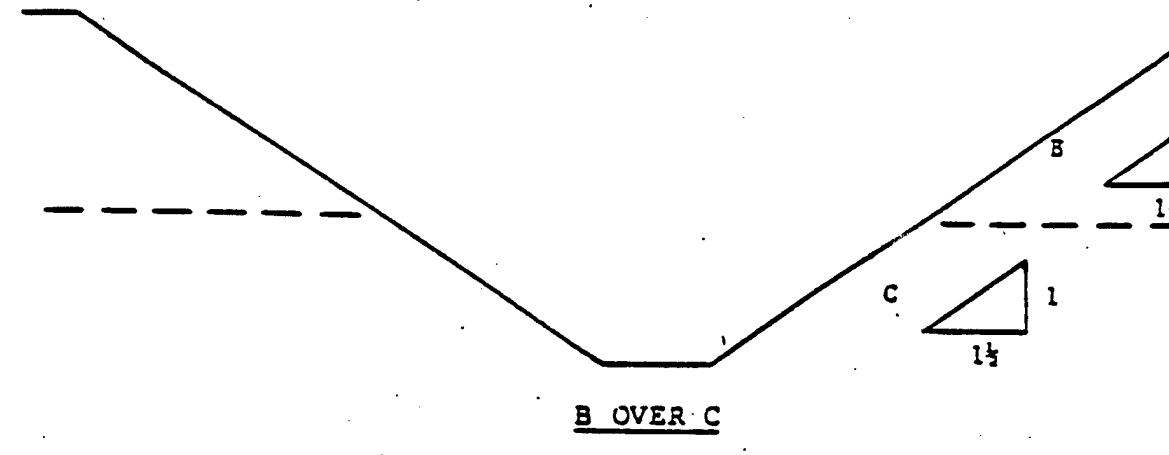
C OVER B



A OVER B



A OVER C



B OVER C

2. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

Appendix C to Subpart P

Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with § 1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in § 1926.652(b) and § 1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil

classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C–1.1, C–1.2, and C–1.3, and Tables C–2.1, C–2.2 and C–2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C–1.1 through C–1.3 and Tables C–2.1 through C–2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C–1.1 through C–1.3 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C–1.1 through C–1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C–2.1 through C–2.3, or have this choice under § 1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with § 1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C–1.1 through C–1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From *Table C–1.1*, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4×4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3×8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement #2

Space 4×6 crossbraces at eight feet horizontally and four feet vertically.

Space 8×8 wales at four feet vertically.

Space 2×6 uprights at four feet horizontally.

Arrangement #3

Space 6×6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8×10 wales at four feet vertically.

Space 2×6 uprights at five feet horizontally.

Arrangement #4

Space 6×6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10×10 wales at four feet vertically.

Spaces 3×8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil in 13 feet deep and five feet wide. From Table C–1.2 three acceptable arrangements of members are listed.

Arrangement #1

Space 6×6 crossbraces at six feet horizontally and five feet vertically.

Space 8×8 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #2

Space 6×8 crossbraces at eight feet horizontally and five feet vertically.

Space 10×10 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #3

Space 8×8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Space 2×6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From Table C–1.3 two acceptable arrangements of members can be used.

Arrangement #1

Space 8×8 crossbraces at six feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Position 2×6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #2

Space 8×10 crossbraces at eight feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Position 2×6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C–1.3. Only one arrangement of members is provided.

Space 8×10 crossbraces at six feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Use 3×6 tight sheeting.

Use of Tables C–2.1 through C–2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in § 1926.652(c), "Design of Protective Systems."

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 36 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

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TABLE C-1.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A $P_a = 25 \times H + 72$ psf (2 ft Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **												
	CROSS BRACES						WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)				VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15			CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				2X6
	UP TO 8	4X4	4X4	4X5	6X6	6X6	4	Not Req'd	---				2X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			2X6	
	UP TO 12	4X6	4X6	6X6	6X6	6X6	4	8X8	4				2X6
10 TO 15	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				3X8
	UP TO 8	4X6	4X6	6X6	6X6	6X6	4	8X8	4		2X6		
	UP TO 10	6X6	6X6	6X6	6X8	6X8	4	8X10	4			2X6	
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	10X10	4				3X8
15 TO 20	UP TO 6	6X6	6X6	6X6	6X8	6X8	4	6X8	4	3X6			
	UP TO 8	6X6	6X6	6X6	6X8	6X8	4	8X8	4	3X6			
	UP TO 10	8X8	8X8	8X8	8X8	8X10	4	8X10	4	3X6			
	UP TO 12	8X8	8X8	8X8	8X8	8X10	4	10X10	4	3X6			
OVER 20	SEE NOTE 1												

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B $P_a = 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES						WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3		
5 TO 10	UP TO 6	4X6	4X6	6X6	6X6	6X6	5	6X8	5			2X6		
	UP TO 8	6X6	6X6	6X6	6X8	6X8	5	8X10	5			2X6		
	UP TO 10	6X6	6X6	6X6	6X8	6X8	5	10X10	5			2X6		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5		2X6			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5		2X6			
	UP TO 10	8X8	8X8	8X8	8X8	8X10	5	10X12	5		2X6			
	See Note 1													
15 TO 20	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	3X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	3X6				
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.3

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C P_a = 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES									UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
5 TO 10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	2X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6				
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
10 TO 15	UP TO 6	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6				
	UP TO 8	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed Oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *
SOIL TYPE A P_a = 25 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X4	4X4	4X6	4	Not Req'd	Not Req'd				4X6	
	UP TO 8	4X4	4X4	4X4	4X6	4X6	4	Not Req'd	Not Req'd					4X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			4X6		
	UP TO 12	4X6	4X6	4X6	6X6	6X6	4	8X8	4				4X6	
10 TO 15	UP TO 6	4X4	4X4	4X4	6X6	6X6	4	Not Req'd	Not Req'd				4X10	
	UP TO 8	4X6	4X6	4X6	6X6	6X6	4	6X8	4		4X6			
	UP TO 10	6X6	6X6	6X6	6X6	6X6	4	8X8	4			4X8		
	UP TO 12	6X6	6X6	6X6	6X6	6X6	4	8X10	4		4X6		4X10	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X6	6X6	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X6	6X6	4	8X8	4	3X6	4X12			
	UP TO 10	6X6	6X6	6X6	6X6	6X8	4	8X10	4	3X6				
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	8X12	4	3X6	4X12			
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.
** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B P_a = 45 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3	4	6
5 TO 10	UP TO 6	4X6	4X6	4X6	6X6	6X6	5	6X8	5			3X12 4X8		4X12
	UP TO 8	4X6	4X6	6X6	6X6	6X6	5	8X8	5		3X8		4X8	
	UP TO 10	4X6	4X6	6X6	6X6	6X8	5	8X10	5			4X8		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5	3X6	4X10			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5	3X6	4X10			
	UP TO 10	6X8	6X8	8X8	8X8	8X8	5	10X12	5	3X6	4X10			
	See Note 1													
15 TO 20	UP TO 6	6X8	6X8	6X8	6X8	8X8	5	8X10	5	4X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X12	5	4X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C P_a = 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES						WALES		UPRIGHTS						
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
5 TO 10	UP TO 6	6X6	6X6	6X6	6X6	8X8	5	8X8	5	3X6				
	UP TO 8	6X6	6X6	6X6	8X8	8X8	5	10X10	5	3X6				
	UP TO 10	6X6	6X6	8X8	8X8	8X8	5	10X12	5	3X6				
	See Note 1													
10 TO 15	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	10X10	5	4X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8X8	8X8	8X8	8X10	8X10	5	10X12	5	4X6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

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Appendix D to Subpart P

Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with § 1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D–1.1, D–1.2, D–1.3 and E–1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D–1.1 and D–1.2 are for vertical shores in Types A and B soil. Tables D–1.3 and D1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D–1.1 through D–1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D–1 Tables. Aluminum material is 6061–T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with § 1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D–1.1, D–1.2, D–1.3 and D–1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D–1.1 and D–1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D–1.3 and D–1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 8 feet deep and 3 feet wide. From Table D–1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 13 feet deep and 5 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 16 feet deep and 9 feet wide. From Table D–1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote #2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically, plywood (per footnote (g)(7) to the D–1 Table) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D–1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D–1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D–1.1, D–1.2, D–1.3, and D–1.4.*

(1) For applications other than those listed in the tables, refer to § 1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to § 1926.652(c)(2) and § 1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5×3.5×0.1875) oversleeves, or structural oversleeves of manufacturer's specification, extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch, thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

(8) See appendix C for timber specifications.

(9) Wales are calculated for simple span conditions.

(10) See appendix D, item (d), for basis and limitations of the data.

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ALUMINUM HYDRAULIC SHORING
TYPICAL INSTALLATIONS

FIGURE NO. 1
VERTICAL ALUMINUM HYDRAULIC SHORING (SPOT BRACING)

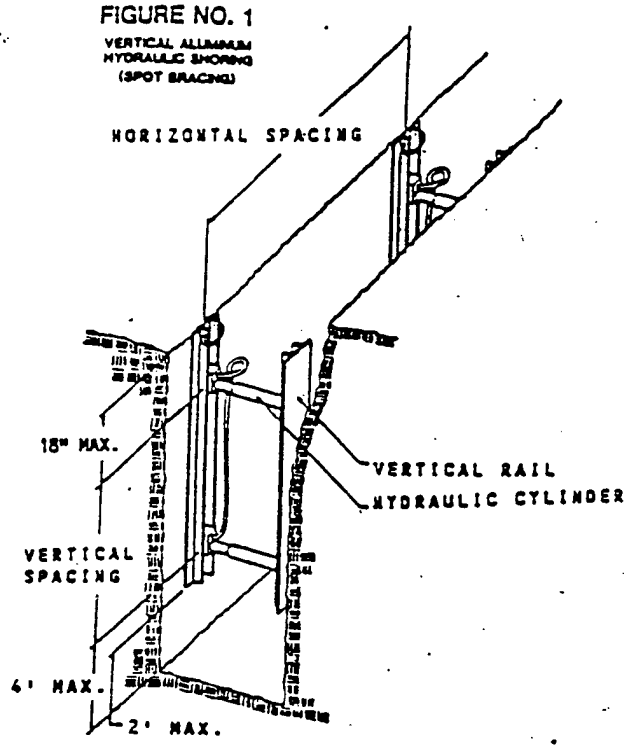

FIGURE NO. 2
VERTICAL ALUMINUM HYDRAULIC SHORING (WITH PLYWOOD)

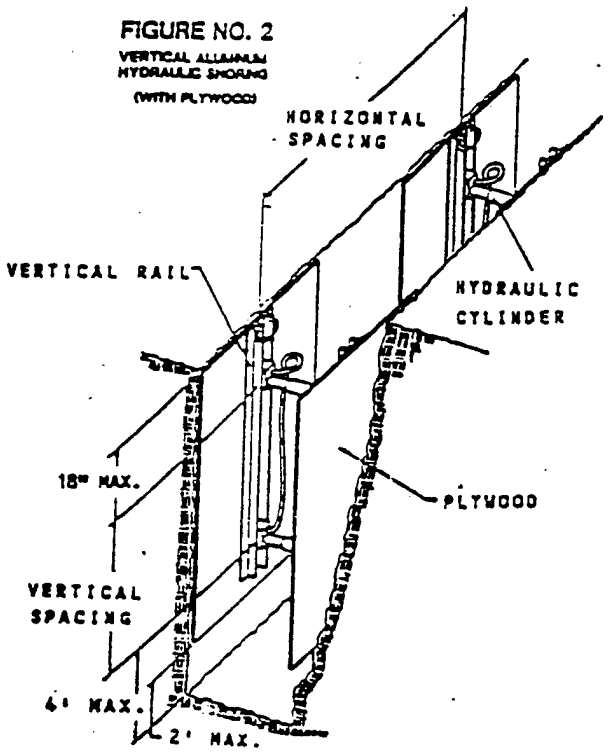

FIGURE NO. 3
VERTICAL ALUMINUM HYDRAULIC SHORING (STACKED)

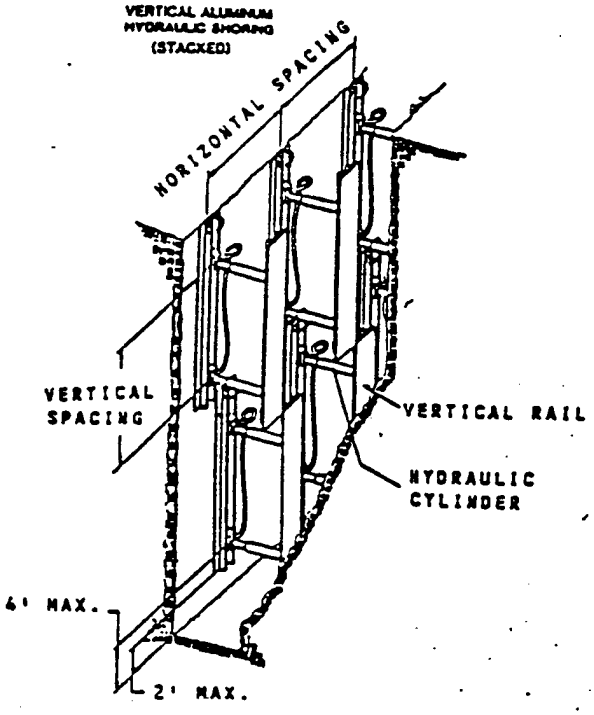

FIGURE NO. 4
ALUMINUM HYDRAULIC SHORING WALER SYSTEM (TYPICAL)

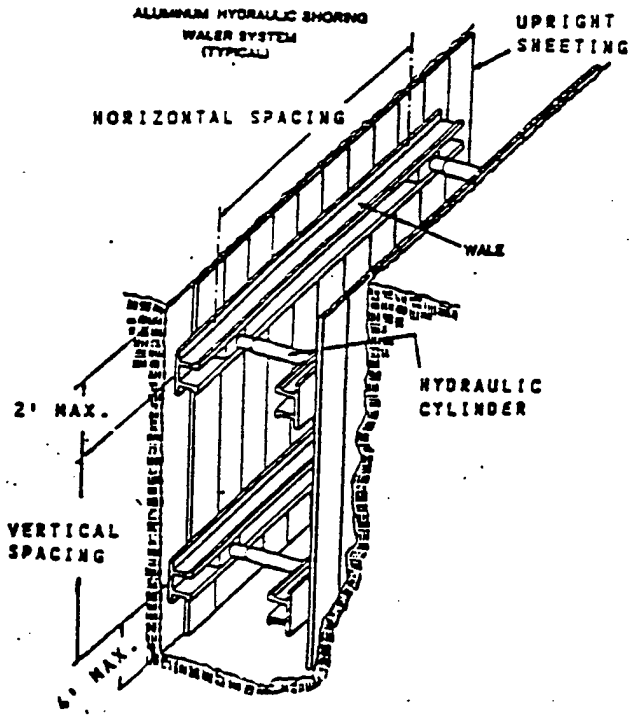

TABLE D - 1.1
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE A

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	8				
OVER 15 UP TO 20	7				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.2
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.3
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX.HORIZ.SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN³) *	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	8.0	2 IN	8.0	2 IN NOTE(2)	8.0	3 IN	——	——	3x12
		7.0	9.0	2 IN	9.0	2 IN NOTE(2)	9.0	3 IN			
		14.0	12.0	3 IN	12.0	3 IN	12.0	3 IN			
OVER 10 UP TO 15	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	——	3x12	——
		7.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 15 UP TO 20	4	3.5	5.5	2 IN	5.5	2 IN NOTE(2)	5.5	3 IN	3x12	——	——
		7.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
		14.0	9.0	3 IN	9.0	3 IN	9.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

TABLE D - 1.4
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX. HORIZ SPACING (ON CENTER)		
			UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15				
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN³) *	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	SOLID SHEET	2 FT.	3 FT.
OVER 5 UP TO 10	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	3x12	—	—
		7.0	6.5	2 IN	6.5	2 IN NOTE(2)	6.5	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE(2)	4.0	3 IN	3x12	—	—
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN			
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE(2)	3.5	3 IN	3x12	—	—
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN			
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

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Appendix E to Subpart P—Alternatives to Timber Shoring

Figure 1. Aluminum Hydraulic Shoring

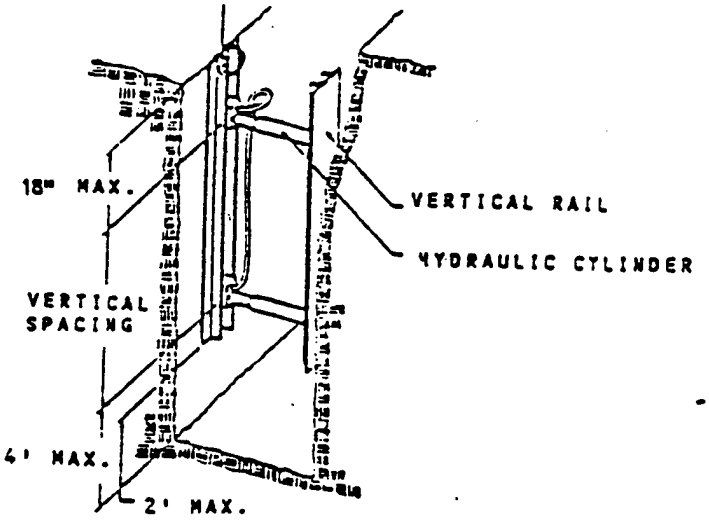
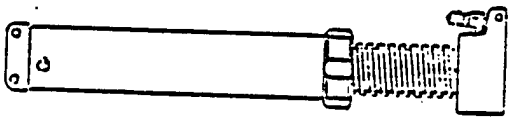


Figure 2. Pneumatic/hydraulic Shoring



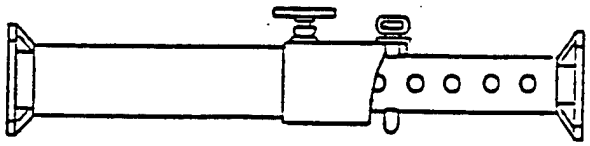


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Figure 3. Trench Jacks (Screw Jacks)

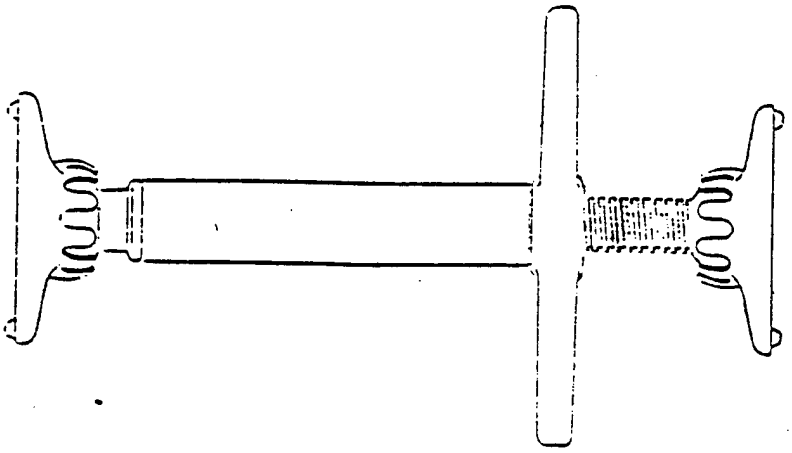
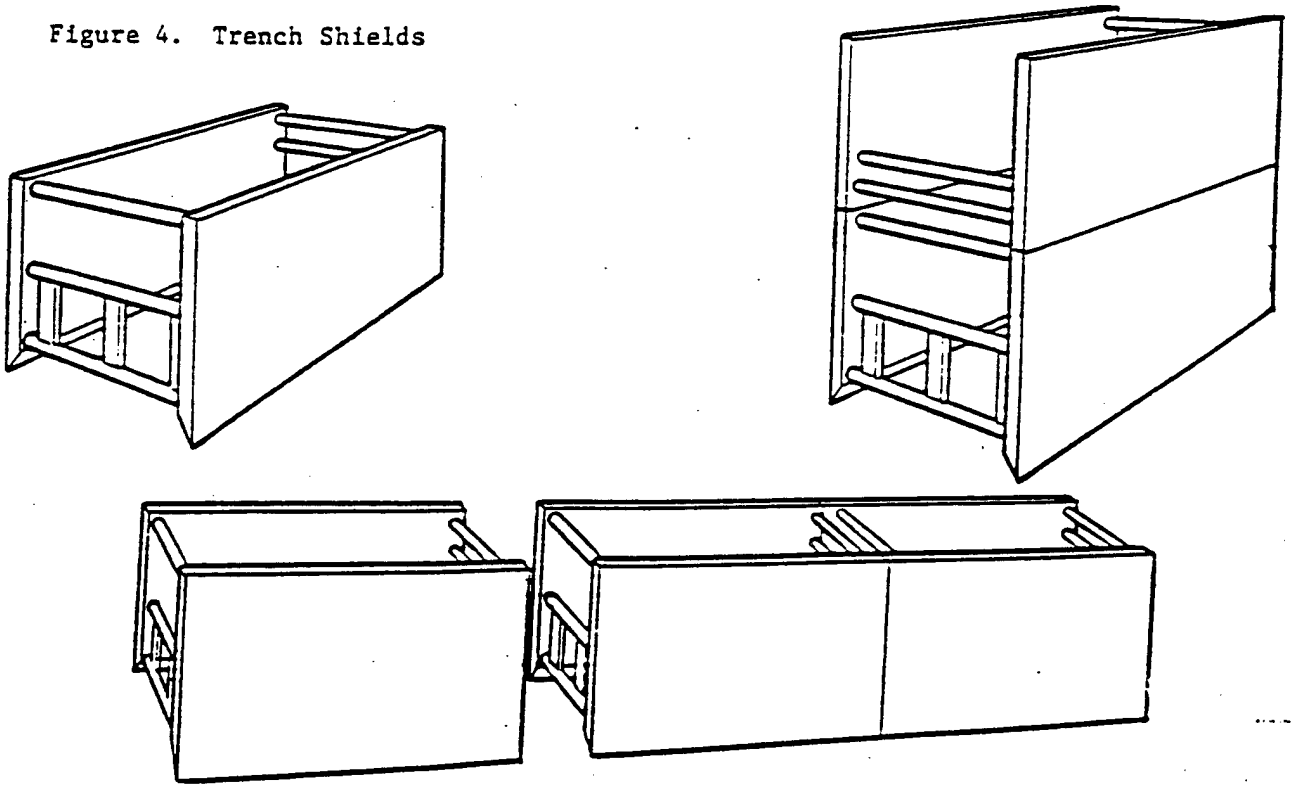


Figure 4. Trench Shields



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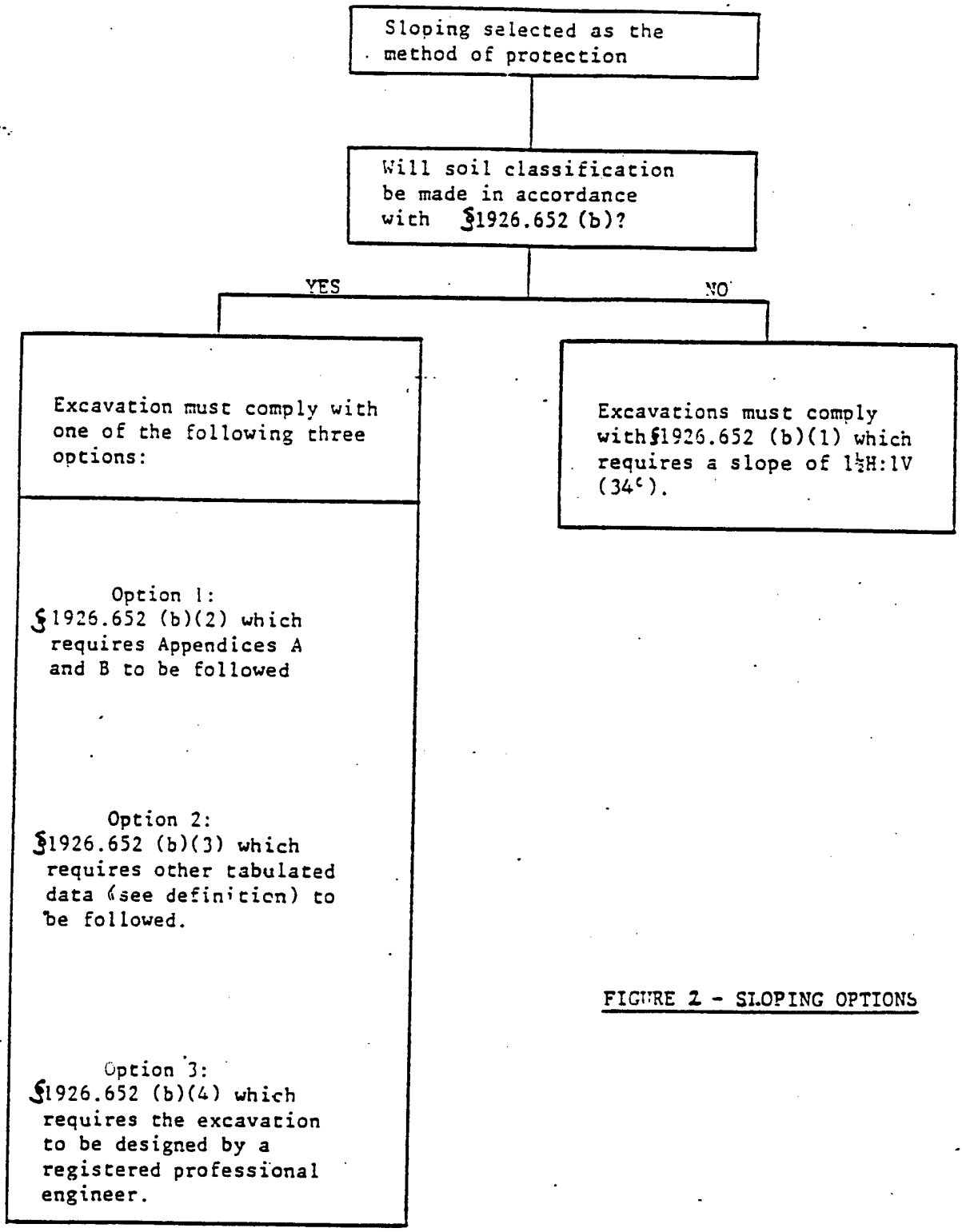

FIGURE 2 - SLOPING OPTIONS

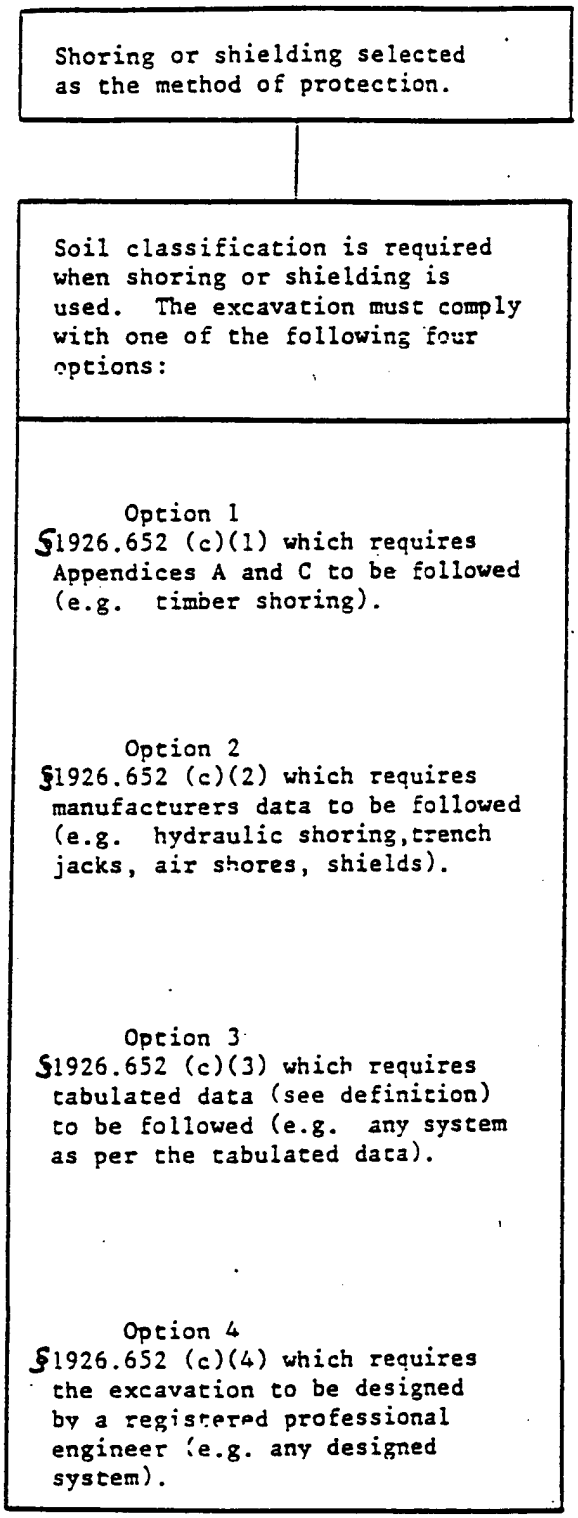

FIGURE 3 - SHORING AND SHIELDING OPTIONS

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Appendix F to Subpart P—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with § 1926.652 (b) and (c).

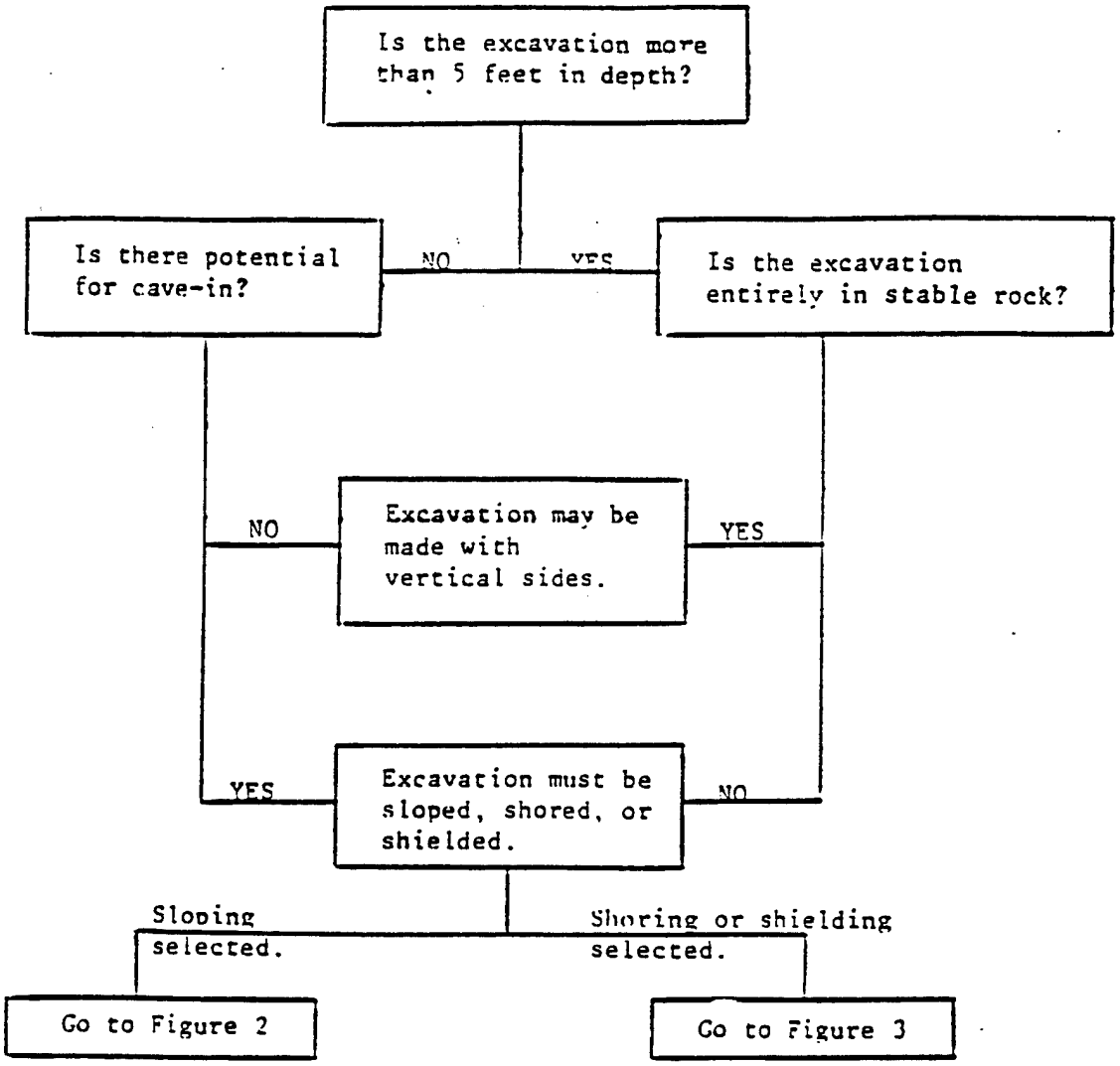

FIGURE 1 - PRELIMINARY DECISIONS

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TEMPERATURE EXTREMES

K.1 HEAT STRESS

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there is increased potential for injury, specifically heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and the prevention of heat stress casualties.

K.1.1 Identification and Treatment

K.1.1.1 Heat Exhaustion.

Symptoms. Heat exhaustion usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, the skin is clammy, and he or she may perspire profusely. The pulse is weak and fast; breathing is shallow. The victim may faint unless he or she lies down. This may pass; however, sometimes it persists and, while heat exhaustion is generally not considered life threatening, death could occur.

First Aid. Immediately remove the victim to the CRZ in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock (i.e., have the victim lie down, raise the feet 6 to 12 inches, and maintain body temperature but loosen all clothing). If the victim is conscious, it may be helpful to give sips of water. Transport the victim to a medical facility.

K.1.1.2 Heat Stroke.

Symptoms. This is the most serious of heat casualties because the body excessively overheats. Body temperatures often are between 107 and 110°F. The victim will have a red face and will not be sweating. First there is often pain in the head, dizziness, nausea, oppression, and dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly. Heat stroke is always serious.

First Aid. Immediately evacuate the victim to a cool and shady area in the CRZ. Remove all protective outer wear and all personal clothing. Lay the victim on his or her back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying

cold wet towels or ice bags to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place the victim in a tub of cool water. The main objective is to cool without chilling. Do not give stimulants. Transport the victim to a medical facility as soon as possible.

K.1.2 Prevention of Heat Stress

One of the major causes of heat casualties is the depletion of body fluids and salts through sweating. Fluids should be maintained in the Support Zone. Salts can be replaced by either a 0.1 percent salt solution, more heavily salted foods, or commercial mixes such as Gatorade. The commercial mixes are advised for personnel on low-sodium diets.

During warm weather, a work schedule will be established that allows most work to be conducted during the morning hours, before ambient air temperature levels reach highs.

A work/rest schedule will be implemented for personnel required to wear Level B or C protection (i.e., an impervious outer garment) with sufficient time allowed for personnel to "cool down" (this may require working in shifts). Two hours is the maximum time between breaks at Level B or C, regardless of temperature. At elevated temperatures, breaks should be scheduled as follows:

Ambient Temperatures	Maximum Time Between Cool Down Breaks
Above 90°F	¼ hour
85° to 90°F	½ hour
80° to 85°F	1 hour
70° to 80°F	1½ hours

K.1.3 Heat Stress Monitoring

Monitoring of personnel wearing impervious clothing should commence when the ambient temperature reaches 70°F, with increased frequency if ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 85°F, workers should be monitored for heat stress after every work period. As a screening

mechanism of the body's recuperative ability to excess heat, one or more of the following techniques should be used.

1. Measure the heart rate (HR) for 30 seconds, by radial pulse, as early in the resting period as possible. At the beginning of the rest period, the HR should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the pulse rate is still above 110 beats per minute at the beginning of the next rest period, the following work cycle should again be shortened by 33 percent.

2. Measure oral body temperature with a clinical thermometer, as early as possible in the resting period. At the beginning of the rest period, oral temperature (OT) should not exceed 99°F. If OT exceeds 99°F, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the OT again exceeds 99°F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should also be measured at the end of the rest period to ensure that it has dropped below 99°F.

3. Maintain good hygienic standards by changing clothes frequently, showering daily, and allowing clothing to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

K.2 COLD STRESS

Cold weather may often cause problems for personnel working outside, even at temperatures above freezing. As temperatures drop below freezing, the potential for cold weather injuries increases dramatically, as does the potential for equipment failure. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0°F (-18°C) or if the windchill factor drops below -29°F (-34°C). These levels represent guidelines that should be used as an action level unless the HSO determines and documents otherwise. Table K-1, which shows equivalent temperatures (i.e., windchill) for a range of ambient conditions, should also be referred to.

Snow and ice increase the risks to personnel and operations through reduced visibility, increased potential for falling injuries, reduced on-site mobility, and the increased time required to access the site (or off-site support services).

In view of these factors, it is critical that the HSO establish site-specific safety and operating protocols, and that all on-site personnel be made aware of the risks.

K.2.1 Local Cold Injuries

Local cold injuries affect specific areas of the body (e.g., fingers, ears, or toes), including the more commonly recognized injuries described in the following subsections.

K.2.1.1 Chilblains. Chilblains is a chronic condition affecting the skin and peripheral capillary circulation, resulting from prolonged exposure of the bare skin, primarily in the extremities, to temperatures at or below 60°F. The best method of preventing and treating chilblains is to cover and protect the skin, thereby avoiding prolonged exposure to the cold.

K.2.1.2 Frostbite. Frostbite is freezing of the hands, feet, ears, and exposed parts of the face as a result of exposure to very low temperatures. Frostbite occurs when ice crystals form in the fluid in cells of the skin and tissue. As long as blood circulation remains good, frostbite will not occur.

There are three stages of frostbite: incipient frost bite (frostnip), superficial frostbite, and deep frostbite. The classification depends on severity and can range from incipient frostbite (frostnip), which affects the skin; to superficial frostbite, which involves the skin and the tissues immediately beneath it; to deep frostbite, which is much more serious with damage that may affect deeper tissue and even bone.

Symptoms. Symptoms for each of the three stages of frostbite are described as follows.

- Frostnip. Skin first turns red and then later becomes pale or waxy white. There may be tingling, stinging, aching, an uncomfortable sensation of coldness or numbness, or no noticeable symptoms.

TABLE K-1

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

HEALTH AND SAFETY PLAN
PART II

ESTIMATED WIND SPEED (in mph)	ACTUAL TEMPERATURE READING (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	EQUIVALENT CHILL TEMPERATURE (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148

(Wind speeds greater than 40 mph have little additional effect.)

LITTLE DANGER
In <hour with dry skin. Maximum danger of false sense of security.

INCREASING DANGER
Danger from freezing of exposed flesh within 1 minute.

GREAT DANGER
Flesh may freeze within 30 seconds.

Trenchfoot and immersion foot may occur at any point on this chart.

Source: Developed by U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts.

- Superficial Frostbite. The skin turns white or gray-white and is waxy in appearance. It is firm to touch (i.e., does not move easily) and the tissue beneath the skin is soft and resilient. There is a lack of sensation in the area.

- Deep Frostbite. The tissue is pale, cold, and solid with possible blisters and swelling. The hands and feet are especially susceptible to deep frostbite.

Emergency Treatment of Frostbite. Frostnip is easily treated in the field by the application of body heat, which should be applied before the affected area becomes numb. If frostnip affects your fingers and hands, place them against the skin of your chest or in your armpits. To warm your face, hold a mitten or scarf over the lower part of your face and breathe into it. Thaw frozen spots immediately. Do not rub affected areas.

Superficial frostbite usually responds to the application of body heat, as described previously. If the skin does not respond to body heat or if it resembles the early stages of deep frostbite, follow the emergency treatments listed in the following paragraphs. DO NOT rub affected areas.

For deep frostbite, if possible, the injured person should be taken to a heated shelter to avoid further frostbite. If it can be done without the danger of further frostbite, remove all constricting items (e.g., boots, gloves, and socks) from the injured area. RAPID REWARMING WILL MINIMIZE TISSUE LOSS. If possible, warm the extremities in a carefully controlled water bath (104 to 106°F) until tips of the fingers or toes turn pink and feeling is restored. If a water bath is not available, either apply wet packs (100 to 112°F) to the person's body, or gently wrap frostbitten area in blankets or some other warm material.

DO NOT attempt to thaw the affected parts by exercising them or heating them in front of an open fire, heat lamp, radiator, or stove. The person could receive a heat injury as a result of sensation loss.

DO NOT use snow to thaw frostbite. DO NOT rub, massage, or use pressure on the affected areas. Keep the frostbitten parts elevated if possible. Watch to see if CPR is necessary. Give the victim warm drinks such as tea, coffee, or soup. DO NOT GIVE ALCOHOLIC BEVERAGES. Have the victim exercise fingers or toes as

soon as possible, but only after they are warmed. DO NOT allow a person with frostbitten feet to walk; walking may cause additional damage.

Medical Treatment of Frostbite.

- Frostnip. Usually does not require medical care.
- Superficial Frostbite. Blisters may require medical care.
- Deep Frostbite. EARLY MEDICAL TREATMENT IS URGENT! Transport the victim to medical care facilities at once.

Prevention of Frostbite. It is far easier to prevent or stop frostbite in earlier stages than to thaw and take care of badly frozen flesh. To protect the body against frostbite, the following precautions should be taken:

- Wear enough clothing to protect against the cold and wind.
- Wear warm gloves and boots.
- Pull a scarf or jacket flap over the lower part of the face or pull a hood tightly around the face.
- Occasionally exercise the face, fingers, and toes to keep them warm and to detect any areas that may have become numb.
- Crew members should watch each other closely, especially the face, for signs of frostbite.

K.2.1.3 Immersion Foot. Immersion foot (formerly called trenchfoot) is a cold injury resulting from prolonged exposure to near-freezing temperatures when standing or walking on wet or swampy ground.

Symptoms. In the early stages, the feet and toes are pale, cold, numb, and stiff, and walking is difficult. If preventive action is not taken, the feet will swell and ache; in extreme cases, this may result in irreversible damage to the tissues of the foot or leg.

Emergency Treatment of Immersion Foot. Handle feet very gently. DO NOT rub or massage. If necessary, clean feet carefully with soap and warm water, then dry, elevate, and expose to warm but not hot air.

Prevention of Immersion Foot. Because the early stages of immersion foot are not painful, crew members must be constantly on the alert and check feet often when working in cold, wet conditions. Keep feet dry by wearing waterproof footgear and changing socks frequently because perspiration, trapped inside waterproof boots or heavy footgear, can contribute to immersion foot symptoms. Avoid standing in wet areas. If feet get wet, dry them as soon as possible, warm them with your hands, then use foot powder, and change to dry socks. If you cannot change wet boots and socks, exercise your feet frequently by wriggling your toes and moving your ankles. Never wear tight boots.

K.2.2 Systemic Cold Injuries

Systemic injuries are those that affect the entire body system. Severe body cooling, known as systemic hypothermia, can occur at temperatures well above freezing. Hypothermia, which can be fatal, is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse. A large percentage of wilderness deaths are the result of hypothermia.

Hypothermia is caused by exposure to cold, and is aggravated by moisture, cold winds, fatigue, hunger, inadequate clothing or shelter, and excessive perspiration from strenuous exercise followed by too rapid cooling.

Hypothermia often occurs between temperatures of 30 to 50°F, which most people believe are not dangerous. Crew members should be alert for symptoms of hypothermia, especially when temperatures are dropping rapidly or when they must work in rain, snow, or ice.

Hypothermia may occur on land or following submersion in even moderately cold water (i.e., 65°F or lower). On land, hypothermia may take a full day or more of exposure to develop; however, if the conditions are extremely severe, death may occur within a few hours of initial symptoms.

In cold water, death may seem to be from drowning; in reality, it is usually the result of hypothermia. In water, skin and nearby tissues chill very fast; in 10 to 15 minutes,

the temperature of the heart and brain may drop. When the core (i.e., internal body) temperature reaches 90°F, unconsciousness may occur; when body temperature drops to 80°F, heart failure is possible.

K.2.2.1 Symptoms. In the early stages of hypothermia, the body begins to lose heat faster than it can be produced, making an effort to stay warm by shivering. When the body can no longer generate enough heat to overcome heat loss and the energy reserves of the body become exhausted, body temperature begins to drop. This affects the ability of the brain to make judgments and also results in loss of muscular control. As the body temperature drops, hypothermia symptoms become increasingly severe, as shown in the following table:

SYMPTOMS OF HYPOTHERMIA	APPROXIMATE CORE TEMPERATURE
Person is conscious, alert with increased respiration. Shivering may become uncontrollable as core temperature nears 95°F.	Above 95°
Person is conscious but disoriented and apathetic. Shivering is present but diminishes as temperature drops. Below 92°F, respiratory rate gradually diminishes and pupils being to dilate.	95° to 90°F
Person is semiconscious. Shivering is replaced by muscular rigidity. Pupils are fully dilated at about 86°F.	90° to 86°F
Unconscious; diminished respiration.	Below 86°F
Barely detectable or nondetectable respiration.	Below 80°F

K.2.2.2 Emergency Treatment of Hypothermia. Move hypothermia victim to shelter and warmth as rapidly as possible. In very mild cases, dry clothing and shelter may be all that is needed. Gently remove all of the victim's wet clothing (so energy is not expended by warming and drying wet clothing) and replace it with a dry set. Give the person something warm to drink. DO NOT GIVE ALCOHOLIC BEVERAGES.

ALL OTHER HYPOTHERMIA CASES SHOULD BE CONSIDERED MEDICAL EMERGENCIES. PROVIDE EXTERNAL HEAT IN ANY WAY POSSIBLE! A warm bath (with the water kept between 105° and 110°F) is the most effective way of warming a victim of hypothermia. NEVER put an UNCONSCIOUS VICTIM in a bathtub.

If it is not possible to give the person a warm bath, use one of the following ALTERNATE METHODS:

- Wrap warm moist towels (or other fabric) around the victim's head, neck, sides, and groin. As the packs cool, rewarm them by adding warm water (approximately 105°F). Check the temperature of the water with your elbow or the inside of your arm; it should be warm but not hot.

- If you are at a remote outdoor location and cannot use the other method, make a "human sandwich" by placing the unclothed victim in a sleeping bag (or between blankets) with two other undressed persons to provide body-to-body heat transfer. THIS WILL SAVE LIVES. Additional sleeping bags or blankets can be placed over and under the victim.

DO NOT wrap a hypothermia victim in a blanket without an auxiliary source of heat unless it is to protect against any further heat loss before treatment can begin, or you need to go for help and there is no other alternative.

Continue treatment once the victim has stabilized. Give warm liquids and nourishing food if the person is conscious. Check the person for symptoms of frostbite and if necessary, give treatment.

Handle the patient gently and do not allow him or her to walk. Exertion can circulate cold stagnant blood from extremities to the central body and cause "after-drop," in which the patient's core temperature drops below the level that will sustain life. ALCOHOL CONTRIBUTES TO AFTER-DROP.

K.2.2.3 Medical Care for Hypothermia. HYPOTHERMIA IS A SEVERE EMERGENCY. GET MEDICAL TREATMENT AS SOON AS POSSIBLE. Even persons with mild hypothermia should see a doctor.

K.2.2.4 Prevention of Hypothermia. In cold weather, never go into the field without wearing adequate clothing. Take a complete change of warm clothes and one or two extra pairs of socks (in plastic bags). Wear or carry a windproof, water-resistant outer jacket and, in rain or snow, wear adequate raingear.

Stay dry. If your clothing becomes wet from perspiration, rain, snow, or immersion in water, change it as soon as possible. If you start to shiver in a prolonged or violent way, seek shelter at once. Shivering may produce heat but it also uses up energy. Violent shivering may be an early sign of hypothermia.

Avoid accidental immersion in water. Practice boat safety and learn cold water survival techniques. If you fall into water and you are not very close to shore, remain quiet. Keep your head out of water, climb onto the boat, or hold or climb onto any other object that will support you and keep you up out of the water.

K.2.3 Safety/First Aid Equipment

In view of the causes, results, and appropriate treatment of cold weather injuries discussed previously, as a minimum, the following safety equipment should be included during cold weather operations:

- extra clothing for all personnel
- blankets and/or sleeping bag
- high-energy food and drinking water supply
- toboggan
- tow ropes

In extreme cold conditions, add the following safety items:

- electric blanket (if an electrical source is available)
- portable emergency generator (with fuel, oil, and cords)
- space heater and fuel

K.2.4 General Winter Operations

Cold weather conditions can severely affect winter operations. The Site Manager and HSO must plan work schedules and project tasks accordingly.

K.2.4.1 Preliminary Assessment. If you will be working outdoors in cold weather, assess the local weather conditions through the news media (i.e., radio, television, and newspapers) to determine whether work should progress and/or the amount of preparation needed. Carefully consider questions such as the following:

- What are the typical wind and weather conditions for the period in which you will be working?
- Are the areas in which you will work sheltered or open to the wind?
- Is there a place nearby for periodic warming breaks? Can you obtain or heat warm food and beverages there? Is there a source of drinking water?
- Are there ways to minimize the length of time that crew members will have to work outdoors in the cold?
- If you use a vehicle for a warming area or will use a heater in a closed room, how can you ensure there is adequate ventilation to prevent carbon monoxide poisoning?

K.2.4.2 Scheduling. Wherever possible, try to schedule work during the least severe weather. Rotate crew members to keep cold exposures short and allow sufficient time for frequent warming breaks. Remember that workers in heavy clothing often need more time to complete the tasks and may become fatigued more easily. Be aware that operations may have to be discontinued if winds increase or the temperature drops.

Because winter days are short, scheduling should allow time for taking care of equipment and supplies before nightfall. Once it becomes dark, it is more difficult to gauge terrain, and temperatures are likely to drop.

K.2.4.3 Site Access. Snow and ice could make travel on site access roads impossible, or treacherous at best. Personnel should not be allowed to work on-site if conditions could severely hamper the arrival or departure of emergency vehicles. If the route to off-site medical facilities is blocked by snow or ice, an otherwise minor injury could result in a major medical emergency. If conditions warrant, the following provisions should be made:

- snow removal/plowing services for site access roads
- a dependable, four-wheel-drive vehicle available to on-site personnel for transporting an injured person to an off-site medical facility
- sleeping bags, blankets, a food supply, and water kept on-site in the event a sudden storm requires personnel to remain overnight

The HSO is responsible for deciding when weather conditions make site access unsafe, thereby requiring work to stop until conditions improve.

K.2.4.4 Equipment and Supplies. Obtain equipment and supplies that will help prevent cold stress and will help in the treatment of cold stress disorders. Required equipment includes a reliable ambient temperature thermometer, a wind gauge, and a windchill chart. If the site is potentially windy due to a lack of natural or manmade windbreaks (e.g., trees, valleys, and structures), try to provide means of shielding workers from the wind. If working at a remote location, carry extra food and water because hunger and dehydration contribute to cold stress. If possible, make provisions for hot food and beverages. Ensure that emergency communication equipment is available and operational for crew members working in the cold, at heights, or in remote locations.

Close attention must be given to the effects of cold weather on field equipment. Batteries can be severely affected by cold resulting in disabled radios, air monitoring equipment, sampling pumps, and vehicles. A supply of fresh batteries, a sufficient number of charging units, and a set of automotive jumper cables should be maintained on-site. In addition, the electronics in many field instruments such as PI, LEL, and oxygen meters, as well as the chemical reactions in detector tubes (e.g., Draeger tubes) can also be adversely affected by the cold. The manufacturers' literature must be consulted for minimum operating temperatures.

If at all possible, monitoring well sampling tasks should not be scheduled during cold weather. These tasks generally require the use of relatively delicate pumps; long, uninsulated stretches of tubing; and significant quantities of decontamination solutions. Unless considerable effort is expended to prevent pumps, hoses, decontamination solutions, and sample containers from freezing, attempting to sample monitoring wells in cold weather may be counter- productive. Portable shelters should be considered if cold weather sampling is necessary.

DECONTAMINATION

L.1 PERSONNEL DECONTAMINATION

Decontamination procedures are followed by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the exclusion and contaminant reduction zones prior to decontamination. A typical personnel decontamination station is shown in Figure L-1. Generalized procedures for removal of protective clothing are as follows:

1. Drop tools, monitors, samples, and trash at designated drop stations (i.e., plastic containers or drop sheets).

2. Step into the designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots.

3. Scrub outer boots and outer gloves with decon solution or detergent and water. Rinse with water.

4. Remove tape from outer boots and remove boots; discard tape and boots in disposal container.

5. Remove tape from outer gloves and remove gloves; discard tape and gloves in disposal container.

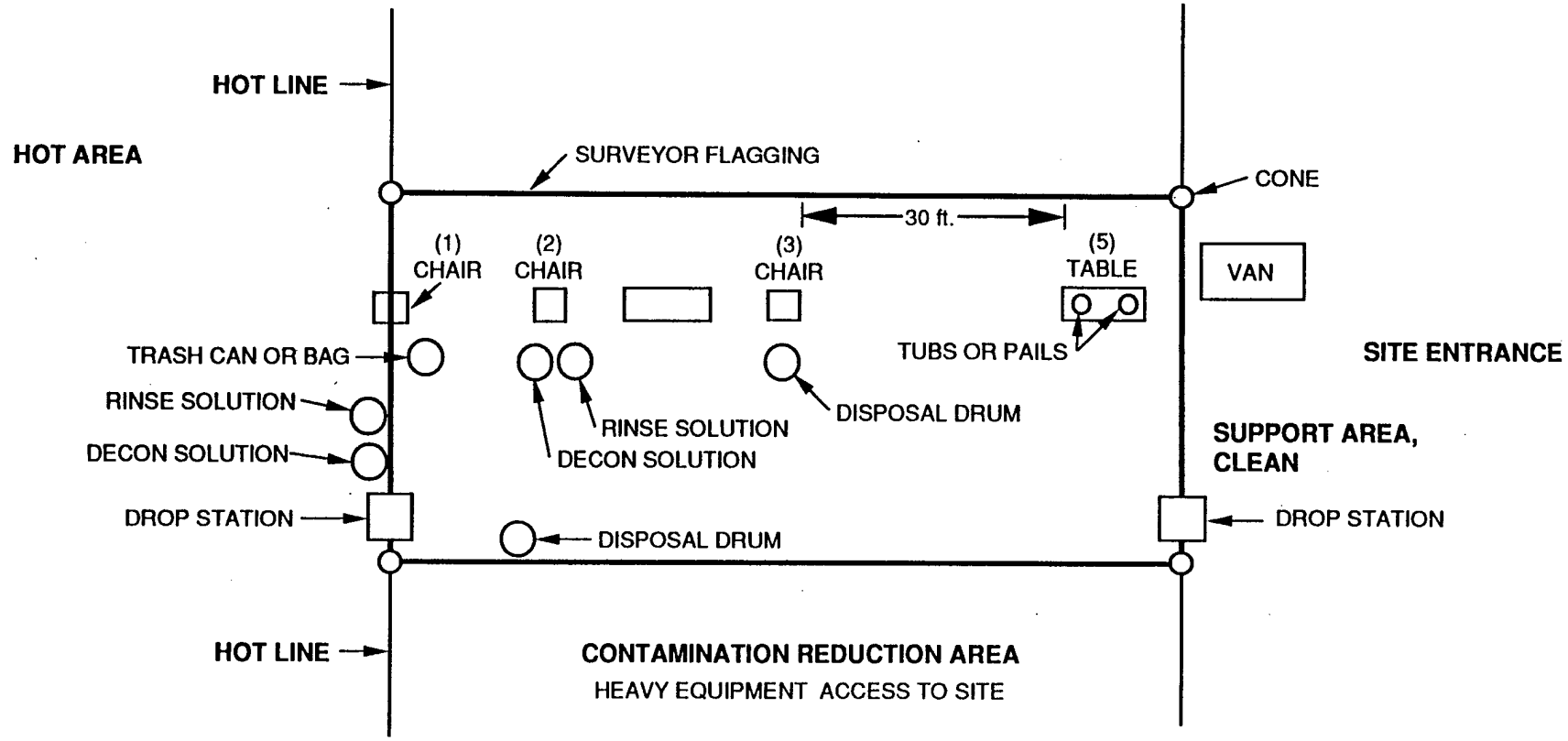
6. If the worker has left the Exclusion Zone to change the air tank on the SCBA or the canister on the air-purifying respirator, this will be the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned, and the joints taped; the worker then returns to duty.

7. Remove outer garments and discard in disposal container.

8. Remove respirator and place or hang in the designated area.

9. Remove inner gloves and discard in disposal container.

10. If the site requires use of a decontamination trailer, all personnel must shower before leaving the site at the end of the work day.



TASK:

(1) WASH OUTER BOOTS - RINSE BOOTS - DISPOSE
(2) WASHOUTER GLOVES - RINSE GLOVES - DISPOSE
(3) SCBA TANK CHANGE OVER TABLE W/SPARE TANKS
(4) REMOVE OUTER GARMENT - DISPOSE
(5) REMOVE SCBA, WASH MASK IN PAILS OR TUBS
(6) REMOVE INNER GLOVES - DISPOSE

NOT TO SCALE

FIGURE L-1
TYPICAL PERSONNEL DECONTAMINATION STATION

ABB Environmental Services, Inc.

NOTE: Disposable items (i.e., Tyvek coveralls, inner gloves, and latex overboots) will be changed daily unless there is reason to change sooner. Dual respirator canisters will be changed daily, unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

Maximum and minimum decontamination layouts for PPE Levels A through C are shown in Figures L-2 through L-6.

Pressurized sprayers or other designated equipment will be available in the decontamination area for washdown and cleaning of personnel, samples, and equipment.

Respirators will be decontaminated daily and taken from the drop area. The masks will be disassembled, the cartridges set aside, and all other parts placed in a cleansing solution. Parts will be pre-coded (e.g., #1 on all parts of Mask #1). After an appropriate time in the solution, the parts will be removed and rinsed with tap water. Old cartridges will be marked to indicate length of use (i.e., if it is possible to evaluate the remaining utility of the cartridge), or discarded in the contaminated trash container for disposal. In the morning, the masks will be reassembled and new cartridges installed, if appropriate. Personnel will inspect their own masks and readjust the straps for proper fit.

L.2 SMALL EQUIPMENT DECONTAMINATION

Small equipment will be protected from contamination as much as possible by draping, masking, or otherwise covering the instruments with plastic (to the extent feasible), without hindering operation of the unit. For example, the PI meter can be placed in a clear plastic bag to allow for reading the scale and operating the knobs. The PI meter can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings will be removed and disposed of in appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes, and dried. The units will be checked, standardized, and recharged as

Figure L-2
Maximum Decontamination Layout
Level A Protection

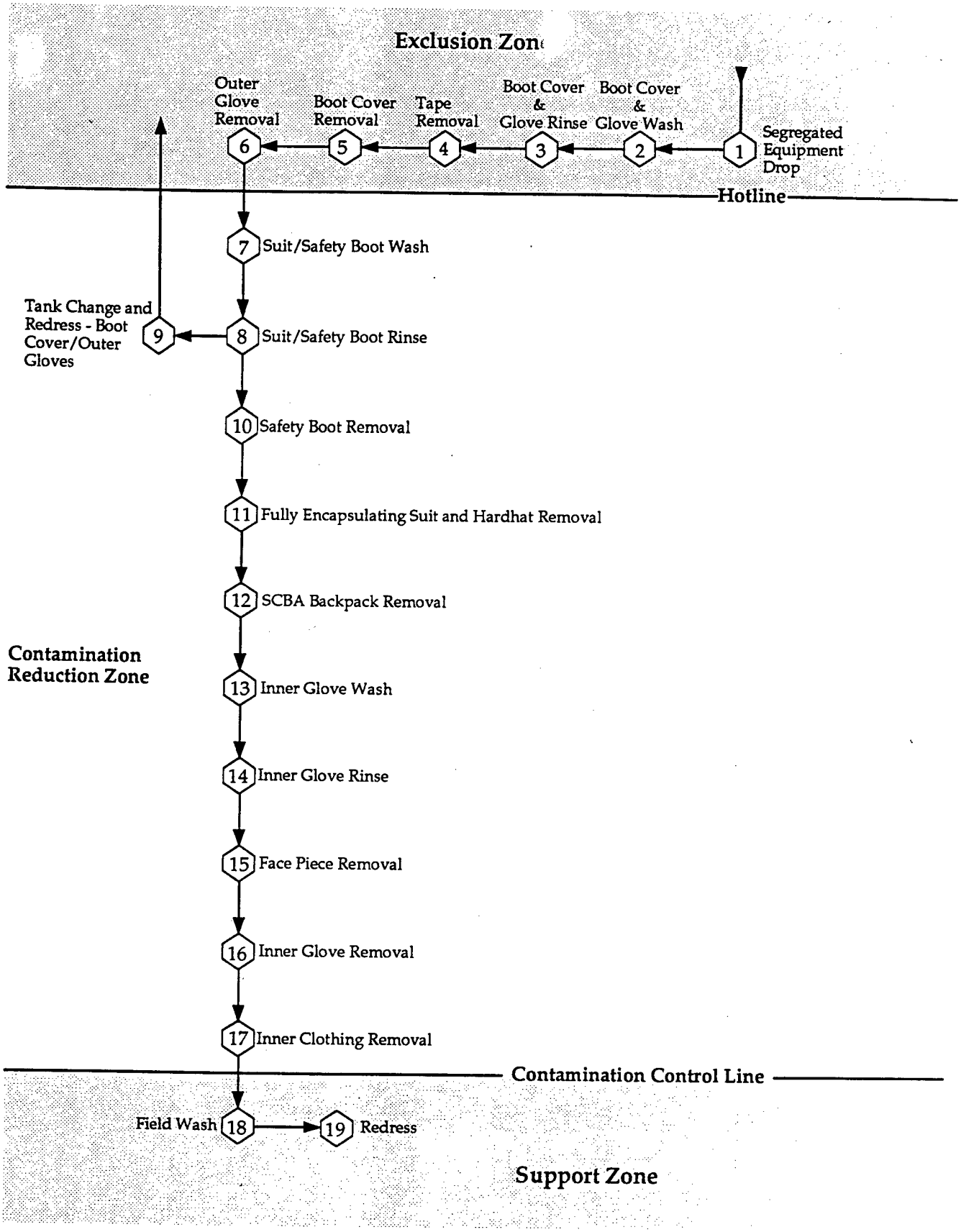


Figure L-3
Maximum Decontamination Layout
Level B Protection

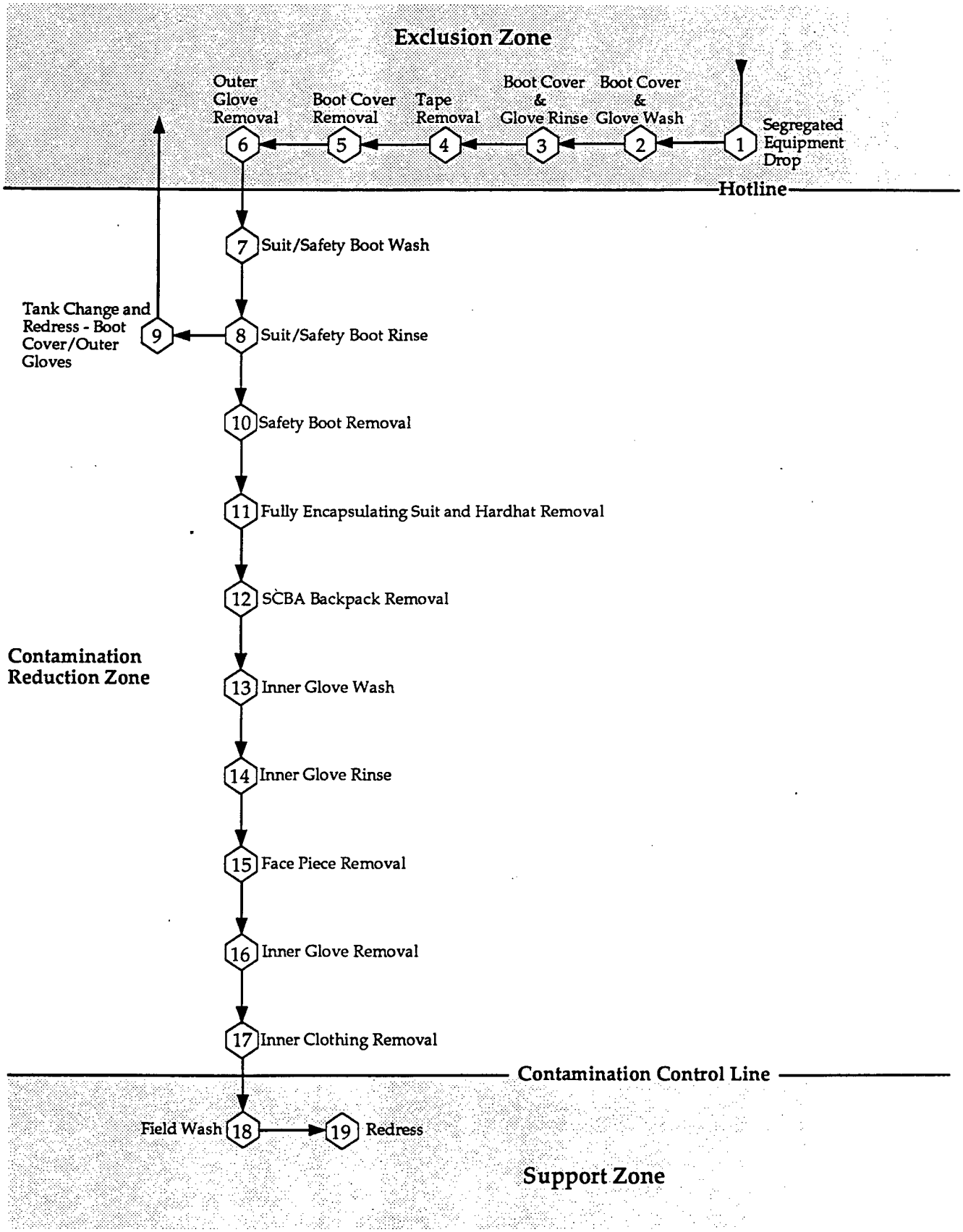


Figure L-4
Maximum Decontamination Layout
Level C Protection

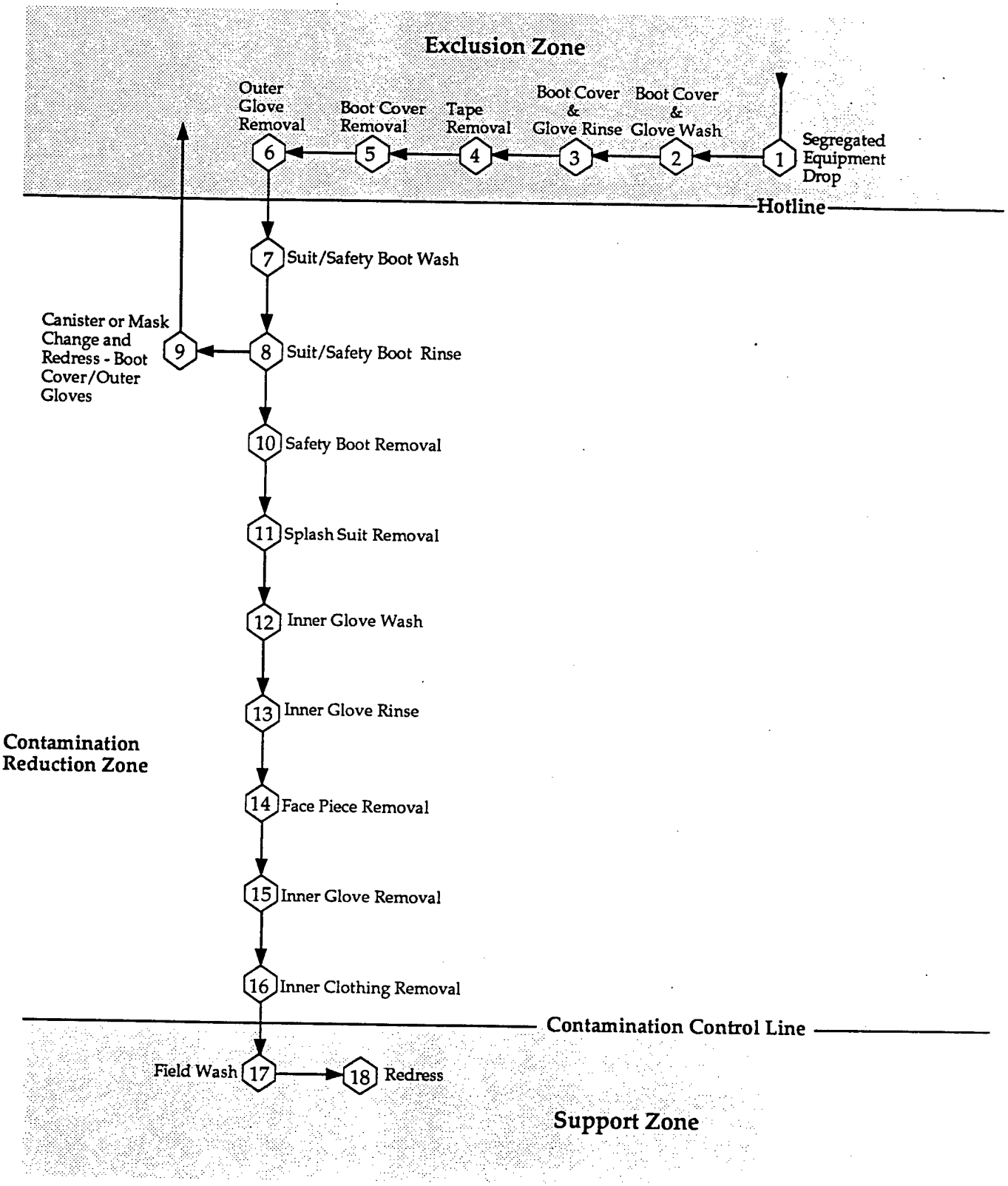


Figure L-5
Minimum Decontamination Layout
Levels A and B Protection

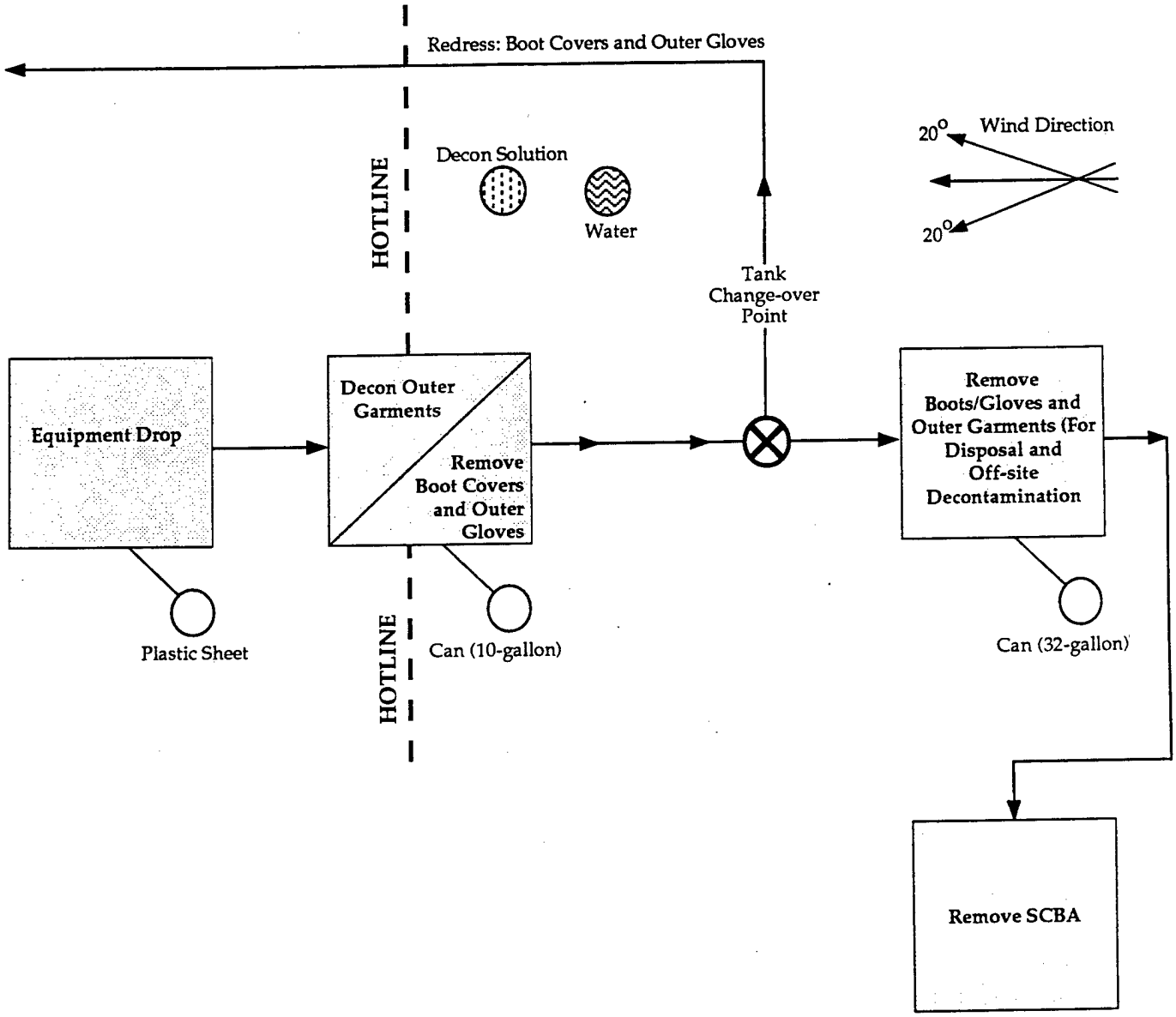
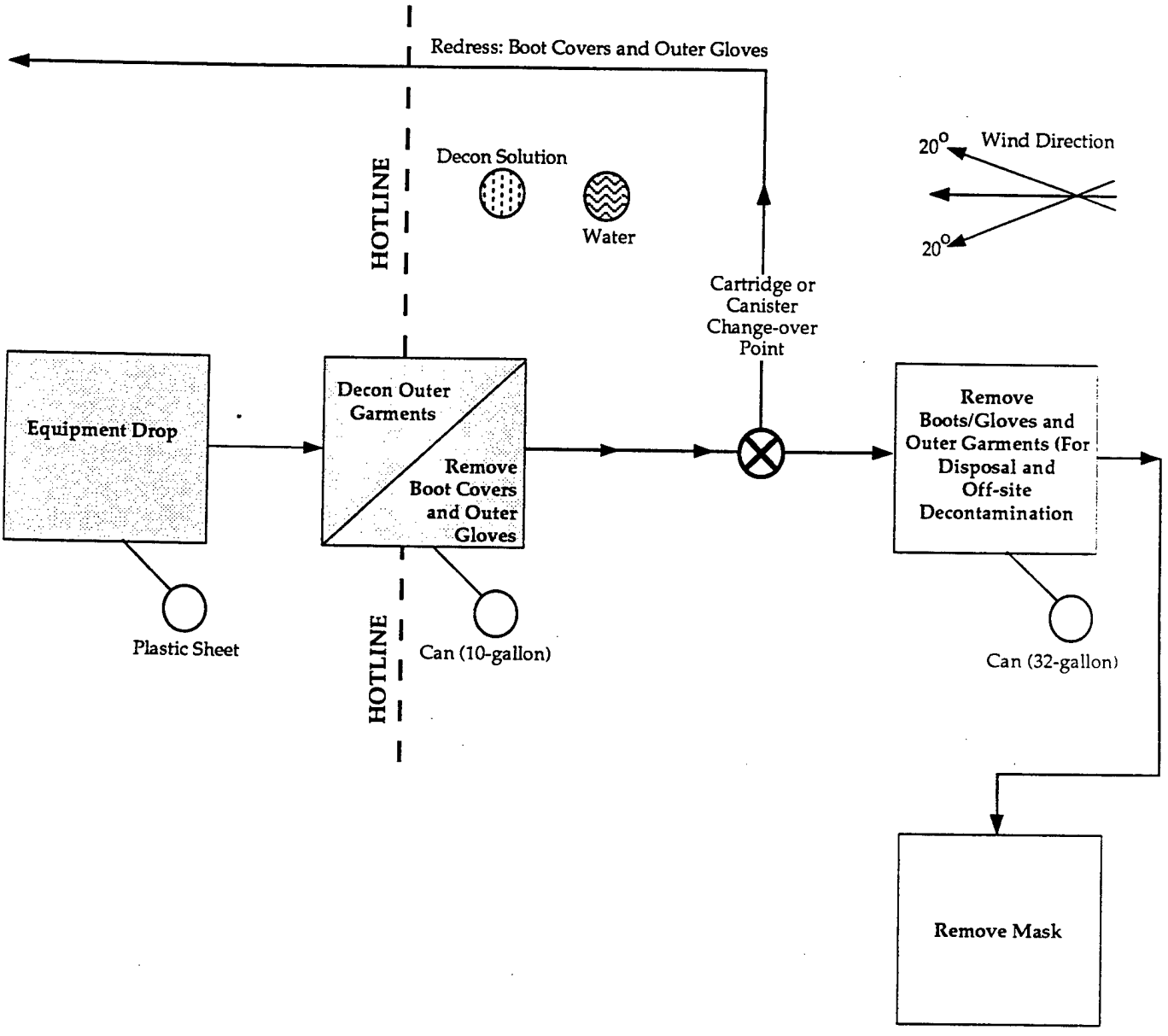


Figure L-6
Minimum Decontamination Layout
Level C Protection



necessary for the next day's operation, and then prepared with new protective coverings.

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