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FINAL REMEDIAL INVESTIGATION FEASIBILITY STUDY WORK PLAN APPENDIX N FOR OERABLE UNIT 3 (OU 3) NAS JACKSONVILLE FL
4/1/1994
ABB ENVIRONMENTAL

FINAL DRAFT

APPENDIX N
OF THE OPERABLE UNIT (OU) 3 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY (RI/FS) WORKPLAN

OU 3 SITE-SPECIFIC HEALTH AND SAFETY PLAN

FOR

NAVAL AIR STATION JACKSONVILLE, FLORIDA

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Jacksonville, Florida

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_x_17.0 OTHER
- ___ ILLUMINATION
- ___ SANITATION
- _x_ HEALTH AND SAFETY AUDIT PROCEDURES

GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
CFR	Code of Federal Regulations
CHRIS	Chemical Hazards Response Information System
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CPT	cone penetrometer testing
DPT	direct push technology
FID	flame ionization detector
FOL	Field Operations Lead
HASP	Health and Safety Plan
HSM	Health and Safety Manager
HSO	Health and Safety Officer
HSS	Health and Safety Supervisor
mg/m^3	milligrams per cubic meter
NADEP	Naval Aviation Depot
NAS	Naval Air Station
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
PPE	personal protective equipment
ppm	parts per million
TOM	Task Order Manager
USEPA	U.S. Environmental Protection Agency

1.0 GENERAL

1.1 SCOPE AND PURPOSE. This Health and Safety Plan (HASP) has been prepared in conformance with the ABB Environmental Services, Inc. (ABB-ES), generic HASP developed under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) District I Contract (CLEAN HASP) and is intended to meet the requirements of 29 Code of Federal Regulations (CFR) 1910.120. As such, the HASP addresses those activities associated with field operations for this project and is supplemental to the NAS Jacksonville HASP. Compliance with this HASP is required for all ABB-ES personnel, contractor personnel, or third parties entering the site.

1.2 PROJECT PERSONNEL.

1.2.1 Task Order Manager The Task Order Manager (TOM) is the individual with overall project management responsibilities. Those responsibilities, as they relate to health and safety, include provision for the development of this site-specific HASP, the necessary resources to meet requirements of this HASP, the coordination of staff assignments to ensure that personnel assigned to the project meet medical and training requirements, and the means and materials necessary to resolve any health and safety issues that are identified or that develop on the project.

1.2.2 Field Operations Leader The Field Operations Leader (FOL) has vested authority from the TOM to carry out day-to-day site operations.

1.2.3 Health and Safety Officer The Health and Safety Officer (HSO) will have at least an indirect line of reporting to the Health and Safety Manager (HSM) through the Health and Safety Supervisor (HSS) for the duration of his assignment as project HSO. The HSO is responsible for developing and implementing this site-specific HASP in accordance with the CLEAN HASP. The HSO will investigate all accidents, illnesses, and incidents occurring onsite. The HSO will also conduct safety briefings and site-specific training for onsite 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 an ABB-ES site in response to health and safety issues. The HSO, in consultation with the HSS or HSM, is responsible for updating and modifying this HASP as site or environmental conditions change. Additional description of the duties of the HSM, HSS, and HSO are provided in Chapter 1.0 of the ABB-ES generic HASP.

1.2.4 Field Engineer or Scientist This category includes engineers, scientist, and technicians who will perform site reconnaissance, cone penetrometer testing (CPT) and drilling monitoring, soil sampling, groundwater sampling, surface water and sediment sampling, and ecological surveys.

1.3 TRAINING. Training is defined in Chapter 3.0 of the CLEAN HASP. All personnel entering potentially contaminated areas at this site must meet the requirements of 29 CFR 1910.120. Personnel without the required training will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange). The ABB-ES training program is described in Chapter 3.0 of the ABB-ES generic HASP.

1.4 MEDICAL SURVEILLANCE. All personnel entering potentially contaminated areas of this site will be medically qualified for site assignment through a medical surveillance program outlined in the ABB-ES generic HASP. Personnel who have not received medical clearance **will not be permitted** in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange). Chapter 4.0 of the CLEAN HASP contains further information on Medical Surveillance Programs. ABB-ES' Medical Surveillance Program is described in Chapter 2.0 of the ABB-ES generic HASP.

2.0 TASK ANALYSIS

2.1 SITE NAME, LOCATION, AND SIZE. Naval Air Station (NAS), Jacksonville, Florida, is located in southern Duval County approximately 9 miles south of downtown Jacksonville. NAS Jacksonville covers approximately 3,800 acres on the west bank of the St. Johns River, upriver from downtown Jacksonville.

This HASP has been developed for use while investigating Operable Unit (OU) 3 at NAS Jacksonville. OU 3 is the primary site on base that supports the Naval Aviation Depot (NADEP). NADEP is one of the five major tenants of NAS Jacksonville and occupies approximately 50 buildings along the northeastern side of the facility. The activities conducted at the NADEP part of OU 3 include stripping, testing, and retrofitting long-range submarine and ground support aircraft. Work includes removal of propellers, control surfaces, and engines. After removal of these items, the airframe is stripped and sprayed with corrosion inhibitors before inspection and repainting. Engines are disassembled, inspected, and moving parts are inspected for cracks and, if necessary, electroplated before assembly and installation on the airframe. In addition to the NADEP area, OU 3 encompasses the area that includes the facility's laundry and dry cleaners.

Field work at OU 3 will include the following tasks:

- site walkovers,
- locational surveys,
- ecological inventories,
- surface water and sediment sampling,
- surface soil sampling,
- subsurface soil sampling,
- test pitting,
- collection of geotechnical information with piezometric CPT equipment,
- groundwater sampling using direct push technology (DPT) equipment,
- piezometer installation,
- monitoring well installation, and
- collection of groundwater samples from monitoring wells.

The hazardous substances, risks, and protective measures identified and described in the following subsections apply to all of these tasks.

2.2 HAZARDOUS SUBSTANCES. Based on available data, the contaminants of concern known or suspected to be present onsite, along with any established exposure limits for those substances, are listed in Tables 2-1 and 2-2.

2.3 SITE RISKS. The health hazards and safety hazards that are anticipated to be encountered at the site are described below.

2.3.1 Health Hazards Personnel may be exposed to volatile and/or semi-volatile contaminants. Hazardous substance information forms (Chemical Hazards Response Information System, CHRIS) for the contaminants of concern are contained in Appendix N 1 of this HASP. All activities at this site will be conducted in unconfined areas. This will help minimize the chances of exposure of onsite personnel to high vapor concentrations of any contaminants.

2.3.2 Safety Hazards Safety hazards include those hazards that personnel may be exposed to that are unrelated to hazardous wastes. These include hazards such as heat stress, operation of and presence around heavy equipment, lifting of objects, and vehicle traffic. Extreme caution should be exhibited by all personnel while conducting work around drill rigs, backhoes, DPT rigs, and other heavy equipment. During hot days, personnel should take time to drink fluids and cool off to avoid overheating and symptoms related to heat stress. Lifting of heavy objects should be done with caution. Personnel should assist one another with moving heavy objects or use the appropriate equipment to accomplish these tasks.

Power substations, power lines, underground utilities, and underground pipelines are to be avoided during drilling operations. Necessary work permits for activities will be obtained from the Public Works Department or the appropriate department (e.g., fire department, etc.).

Safety hazards and methods to reduce employee exposure to hazardous substances is addressed in the ABB-ES generic HASP in Appendix 6.0, Personal Protective Equipment; Section 12.5, Monitoring Equipment; Chapter 6.0; Chapter 7.0, Work Practices; Appendix G, Confined Space Entry Procedures (not planned for this work); Chapter 10.0, Temperature Extremes; Chapter 8.0, Decontamination, and Chapter 9.0, Emergency Planning.

2.3.3 Health and Safety Assessment Based on the available information (nature of the work, potential onsite chemicals and their properties, exposure limits, etc.), hazards associated with conducting the described field work are considered to be low, assuming appropriate health and safety practices are maintained.

2.4 PROTECTIVE MEASURES. The following are the protective measures that will be used at the site.

2.4.1 Engineering Controls Whenever needed, engineering controls (e.g., fans to blow volatilized chemicals away from the work area) will be used. Engineering controls are described in more detail in Section 7.4 of the ABB-ES generic HASP; however, it is anticipated that engineering controls will not be necessary during the RI field work.

Table 2-1
Contaminants of Concern in Groundwater

OU 3 Site-Specific Health and Safety Plan
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Jacksonville, Florida

Constituent	Maximum [1] Reported Conconcentration	PEL/TLV[2]
Volatile Organic Compounds (VOCs)		
1,1,1-Trichloroethane	106,000	350
1,1-Dichloroethane	42,000	100
1,1-Dichloroethene	53,500	1
1,2-Dichloroethene (total)	7,000	200
2-Butanone	6,000	200
4-Methyl-2-pentanone	14,000	50
Chloroethane	4,000	1,000
cis-1,2-Dichloroethene	4,900	1
Methylene chloride	94,000	50
Tetrachloroethene	9,600	25
Toluene	3,000	50
trans-1,2-Dichloroethene	8,000	200
Trichloroethene	155,300	50
Vinyl chloride	2,000	1
Semivolatile Organic Compounds (SVOCs)		
2,4-Dimethylphenol	5	–
2-Methylnaphthalene	20	–
2-Methylphenol	27	–
bis(2-Chloroethyl)ether	17	–
bis(2-Ethylhexyl)phthalate	10	–
Naphthalene	310	10
Metals		
Chromium	255	–

[1] Concentrations reported in parts per million (ppm) for metals and parts per billion (ppb) for SVOCs and VOCs).
[2] Permissible exposure limit/threshold limit value (in ppm).

Table 2-2
Contaminants of Concern in Soil

OU 3 Site-Specific Health and Safety Plan
NAS Jacksonville
Jacksonville, Florida

Constituents	Maximum [1] Reported Concentration	PEL/TLV[2]
Volatile Organic Compound (VOCs)		
1,1,1-Trichloroethane	5,460,000	350
1,1-Dichloroethane	2,260	300
1,1-Dichloroethene	9,640	1
1,3-Dichlorobenzene	1,550	–
1,4-Dichlorobenzene	1,020	10
Benzene	1,200	1
Chloroform	3,120	2
Ethylbenzene	4,300	100
m/p-Xylene	2,800	100
Methylene chloride	2,380	50
o-Xylene	1,400	100
Tetrachloroethene	13,000	25
Toluene	17,100	50
Trichloroethene	18,300	50
Unknown HC as o-Xylene	140,000	–
Xylene (total)	4,500	100
Semivolatile Organic Compounds (SVOCs)		
2-Methylnapthalene	600	–
Benzo(a)anthracene	370	–
Benzo(a)pyrene	390	–
Benzo(b)fluoranthene	540	–
bis(2-Ethylhexyl)phthalate	950	–
Chrysene	390	–
Di-n-butylphthalate	140	–
Diethylphthalate	140	–
Fluoranthene	790	–
Fluorene	180	–
Naphthalene	520	10
Phenanthrene	800	–
Phenol	3,200	–
Pyrene	450	–
Metals		
Arsenic	200	–
PCBs		
Aroclor	220	–

[1] Concentrations reported in parts per million (ppm) for metals and parts per billion (ppb) for SVOCs and VOCs.
[2] Permissible exposure limit/threshold limit value (in ppm).

2.4.2 Levels of Protection Level D personal protective equipment (PPE) will only be used when the atmosphere contains no known hazard, all potential airborne contaminants can be monitored for, and work functions preclude splash, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemical. It is anticipated that work at OU 3 may require limited modified Level D protection. Modified Level D is Level D protection with the addition of chemical protective clothing. Modified Level D does not include respiratory protection.

Higher levels of personal protection will be used as dictated by conditions discovered in the field and as directed by the HSO. Guidance on selection of the level of personal protection is provided in Subsection 2.5.1 of this HASP and Chapter 6.0 of the ABB-ES generic HASP.

2.5 MONITORING. It is intended that real time monitoring instrumentation will be used to monitor the work environment to ensure the appropriate level of protection for the site team.

2.5.1 Air Sampling 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 the levels of protection in conformance with action levels provided in this HASP and at the direction of the site HSO.

A respirable dust monitor will be used at the site in areas where semivolatile contamination associated with dry dusty conditions exists. If the monitor reads $\geq$ 5 milligrams per cubic meter (mg/m^3), the field team will withdraw from the site.

A Foxboro™ organic vapor analyzer (OVA) Model 128 equipped with a flame ionization detector (FID) and Draeger tubes will be used at the site. It is anticipated that all work can be accomplished at Level D personal protection. If the FID or Draeger tube readings exceed background, modified level D will be required.

The breathing zone will be monitored continuously with an FID. If the FID readings exceed background, monitoring will continue with vinyl chloride 0.5/a and benzene 5c Draeger tubes. If vinyl chloride levels are equal to or greater than 0.5 part per million (ppm), PPE will be upgraded to level B. If benzene levels read equal to or greater than 0.5 ppm, PPE will be upgraded to level C. If vinyl chloride and benzene remain less than 0.5 ppm, PPE will continue at modified level D until the FID reads 9 ppm. PPE will then be upgraded to level C until the FID reads greater than or equal to 500 ppm, then the PPE will be upgraded to level B.

Level D or (modified) is acceptable if:

- FID < 9 ppm, or
- vinyl chloride 0.5/a Draeger tube < 0.5 ppm.

Level C required if:

- FID reads between 5 and 500 ppm, and/or
- vinyl chloride 0.5/a Draeger tube reads <0.5 ppm, or
- benzene 5c Draeger tube reads between 0.5 and 50 ppm.

Level B required if:

- FID reads ≥ 500 ppm, and/or
- vinyl chloride Draeger tube reads ≥ 0.5 ppm, or
- benzene Draeger tube reads ≥ 50 ppm.

Refer to Chapter 7.0 of the CLEAN HASP for information on the calibration and maintenance of the equipment. Additional monitoring equipment that may be used at the site is described in Section 7.3 of the ABB-ES generic HASP.

No intrusive work will be started on this site without first clearing the area of proposed work with a radiation meter to verify that no radiation danger exists.

2.5.2 Personal Monitoring Personal monitoring will be undertaken to characterize the personal exposure of high risk employees to the hazardous substances they may encounter onsite. Personal monitoring will be conducted on a representative basis. Personnel who conduct a high risk work task will be noted in field logs. Thermoluminescent dosimetry body badges will be used by all workers at the site.

3.0 SITE CONTROL

3.1 ZONATION. The general zonation protocols that should be employed at hazardous waste sites are described in Chapter 8.0 of the CLEAN HASP. The site-specific zonation that will be used for this project is described below.

Due to the nature of the work (multiple soil borings and monitoring well installations, and DPT groundwater sampling throughout the study area) and the properties of the potential chemicals found onsite, typical exclusion, contamination reduction, and support zones are not necessary or practical at all locations, especially because the surface of the area is primarily covered by concrete pavement. Therefore, where appropriate, such as test pitting operations at PSC 15, a "floating" exclusion zone in the perimeter of the sampling site will be established to eliminate access to the area by individuals not working on the project or involved in the assessment work. The perimeter will be at least 30 feet in radius and will be moved accordingly as the assessment points are moved.

Zonation of waste sites and "floating" decontamination stations are described in the ABB-ES generic HASP in Chapter 5.0, Site Control, and Chapter 8.0, Decontamination. A decontamination area will be established in OU 3 and will consist of a decontamination pad and associated vessels to contain the decontamination fluid. The purpose of the decontamination pad is to provide a central area for the decontamination of field sampling equipment, vehicles, and large field equipment (tractors, drill rigs, trucks, etc).

3.2 COMMUNICATIONS. When radio communication is not used, the following air horn signals will be employed:

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

The air horn will be kept in the Exclusion Zone or Support Zone. Site communication and work practices are discussed in more detail in Chapter 7.0 of the ABB-ES generic HASP.

3.3 WORK PRACTICES. General work practices to be used during ABB-ES projects are described in Chapter 9.0 of the CLEAN HASP. Work at the Site will be conducted according to these established protocol and guidelines for the safety and health of all involved. Specific work practices necessary for this project or those that are of significant concern are described as follows.

- Work and sampling will be conducted in Level D clothing and equipment, unless site-specific conditions are discovered that require a higher level of personal protection. Zonation of site work areas, typical work practices, and levels of personal protection are discussed in the ABB-ES generic HASP in Chapter 5.0, Site Control; Chapter 7.0, Work Practices; and Chapter 8.0, Decontamination.

4.0 DECONTAMINATION AND DISPOSAL

All personnel and/or equipment leaving contaminated areas of the site will be subject to decontamination, which will take place in the contamination reduction zone. The decontamination areas will consist of a temporary "fixed" decontamination station constructed at OU 3 and "floating" decontamination stations for each work site. General decontamination practices are described in Chapter 13.0 of the CLEAN HASP and in Chapter 8.0 of the ABB-ES generic HASP.

4.1 PERSONNEL DECONTAMINATION. All personnel leaving the study area are subject to decontamination (as necessary). The decontamination procedure required will be determined by the nature and level of contamination found at the sites. At a minimum, site personnel will remove loose soils from boots and clothing before leaving the site. More thorough decontamination procedures will be observed as dictated by site conditions.

4.1.1 Small Equipment Decontamination Small equipment will be protected from contamination as much as possible by keeping the equipment covered when at the site and by placing the equipment on plastic sheeting, not the ground. Sampling equipment used at the site will be used only once or will be field cleaned between samples. Small equipment (e.g., split spoons, hand augers, etc.) will be decontaminated at each work site. Small equipment decontamination is described in more detail in Section 8.3 of the ABB-ES generic HASP.

4.1.2 Heavy Equipment Decontamination Drilling equipment will be protected from contamination as much as possible by placing the equipment on plastic sheeting, not the ground. The drill rig and associated drilling equipment will be cleaned with high pressure water or high pressure steam followed by a soap and water wash and rinse at a centralized decontamination station located in OU 3. Loose material will be removed by brush. The person performing this activity will be at the level of protection used during the field investigation. Heavy equipment decontamination is described in more detail in Section 8.4 of the ABB-ES generic HASP.

4.2 COLLECTION AND DISPOSAL OF DECONTAMINATION PRODUCTS. All disposable protective gear, decontamination fluids (for both personnel and equipment), and other disposable materials will be disposed at the site. Disposable material (e.g., gloves and any Tyveks™ if required) will be bagged and disposed properly. Collection and disposal of decontamination products is described in more detail in Section 8.5 of the ABB-ES generic HASP and in Chapter 4.0 of the OU 3 Field Sampling Plan.

5.0 EMERGENCY AND CONTINGENCY PLAN

This chapter identifies emergency and contingency planning that has been undertaken for operations at this site. Most sections of the HASP provide information that would be used under emergency conditions. General emergency planning information is addressed in Chapter 14.0 of the CLEAN HASP and Chapter 9 of the generic ABB-ES HASP. The following sections present site-specific emergency and contingency planning information.

5.1 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATION. The site HSO or the Health and Safety designee is the primary authority for directing operations at the site under emergency conditions. All communications both onsite and offsite will be directed through the HSO or designee.

5.2 EVACUATION. Evacuation procedures at the site will follow those procedures discussed in Chapter 14.5 of the CLEAN HASP for upwind withdrawal, site evacuation, and evacuation of the surrounding area.

Upon determining that conditions warrant site evacuation, the work party will proceed upwind of the work site and notify the security force, HSO, and the 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 gloves, monitoring equipment etc. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office, only if upwind, or the designated rally point to assess the situation. There the respirators may be removed (if instrumentation indicates an acceptable condition). As more facts are determined from the field crew, these will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the HSO.

5.3 EMERGENCY MEDICAL TREATMENT AND FIRST AID. Any personnel injured onsite will be rendered first aid as appropriate and transported to competent medical facilities for further examination and/or treatment. The preferred method of transport is through professional emergency transportation means; however, when this is not readily available or would result in excessive delay, other transport will be authorized. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

6.0 ADMINISTRATION

6.1 PERSONNEL AUTHORIZED DOWNRANGE. Personnel authorized to participate in downrange activities at this site have been reviewed and certified for site operations by the TOM and the HSS. Certification involves the completion of appropriate training, a medical examination, and a review of this site-specific HASP. All persons entering the site must use the buddy system, and check in with the FOL and/or HSO before going downrange.

CERTIFIED ABB ENVIRONMENTAL TEAM PERSONNEL:

To Be Determined	Technical Lead
"	Field Operations Leader
"	Field Engineer/Scientist (HSO)
"	Field Engineer/Scientist
"	Field Engineer/Scientist
"	Field Engineer/Scientist

* FIRST-AID-TRAINED
\+ CPR-TRAINED

6.2 HEALTH AND SAFETY PLAN (HASP) APPROVALS. By their signatures, the undersigned certify that this HASP will be used for the protection of the health and safety of all persons entering this site.

_____ _____
Health and Safety Officer Date

_____ _____
Project Manager Date

_____ _____
Health and Safety Manager/Supervisor Date

6.3 FIELD TEAM REVIEW. I have read and reviewed the health and safety information in the HASP. I understand the information and will comply with the requirements of the HASP.

NAME: _____

DATE: _____

SITE/PROJECT: _____

NOTE: THIS REVIEW VERIFICATION MUST BE SIGNED BY ALL FIELD PERSONNEL PRIOR TO WORKING ONSITE.

6.4 MEDICAL DATA SHEET. This Medical Data Sheet will be completed by all onsite personnel and will be kept in the Support Zone during site operations. It is not a substitute for the Medical Surveillance Program requirements consistent with the CLEAN HASP. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required. If more space is required, use the back of this sheet.

Project: _____

Name: _____

Address: _____

Home Telephone: Area Code ( ) _____

Age: _____ Height: _____ Weight: _____

In case of emergency, contact: _____

Address: _____

Telephone: Area Code ( ) _____

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

Allergies: _____

List medication(s) taken regularly: _____

Particular sensitivities: _____

Previous/current medical conditions or exposures to hazardous chemicals:

_____

Name of Personal Physician: _____

Telephone: Area Code ( ) _____

6.5 EMERGENCY TELEPHONE NUMBERS.

NAS Jacksonville

Police Department	911
Rescue Service	911
St. Vincents Hospital	(904) 387-7395
Riverside Hospital	(904) 387-7070

Other Contacts

National Poison Control Center	(800) 492-2414
Florida Poison Control Center	(800) 282-3171
National Response Center	(800) 424-8802
Regional USEPA Emergency Response	(800) 414-8802
Chemical Manufacturers Association	
Chemical Referral Center	(800) 262-8200
Site HSO: To Be Determined	
Task Order Manager: Peter Redfern	(904) 269-7012
Regional HSS: To Be Determined	
ABB Environmental HSM: Cindy Sundquist	(800) 341-0460 ext. 3309

EMERGENCY CONTACTS

Dr. David Barnes	(800) 229-3674
ABB-ES (Maine)	(800) 341-0460 ext. 3309 or ext. 3380
ABB-ES (Orange Park, Florida)	(904) 269-7012
USEPA Emergency Response	(800) 414-8802

6.6 ROUTES TO EMERGENCY MEDICAL FACILITIES. The primary source of medical assistance for the site is:

Facility Name: Saint Vincents Hospital

Address: 1800 Barrs St., Jacksonville, FL

Telephone Number: (904) 387-7395

Directions to primary source of medical assistance: (attach map)

Exit NAS via the main gate and take a right onto Roosevelt Blvd. (Hwy 17) heading north.

Proceed north to Park Street and take a right (east) onto Park Street.

Proceed on Park to Barrs Street and take a right. At the end of Barrs Street, on the right, is St. Vincents.

Alternative source of medical assistance:

Facility Name: Riverside Hospital

Address: 2033 Riverside Avenue, Jacksonville, FL

Telephone Number: (904) 387-7070

Directions to alternate source of medical assistance: (attach map)

Exit NAS via the main gate and take a right onto Roosevelt Blvd. (Hwy 17) heading north.

Proceed north to Park Street and take a right (east) onto Park Street.

Proceed on Park Street to Margaret Street and take a right.

At the corner of Margaret Street and Riverside is Riverside Hospital on the right.

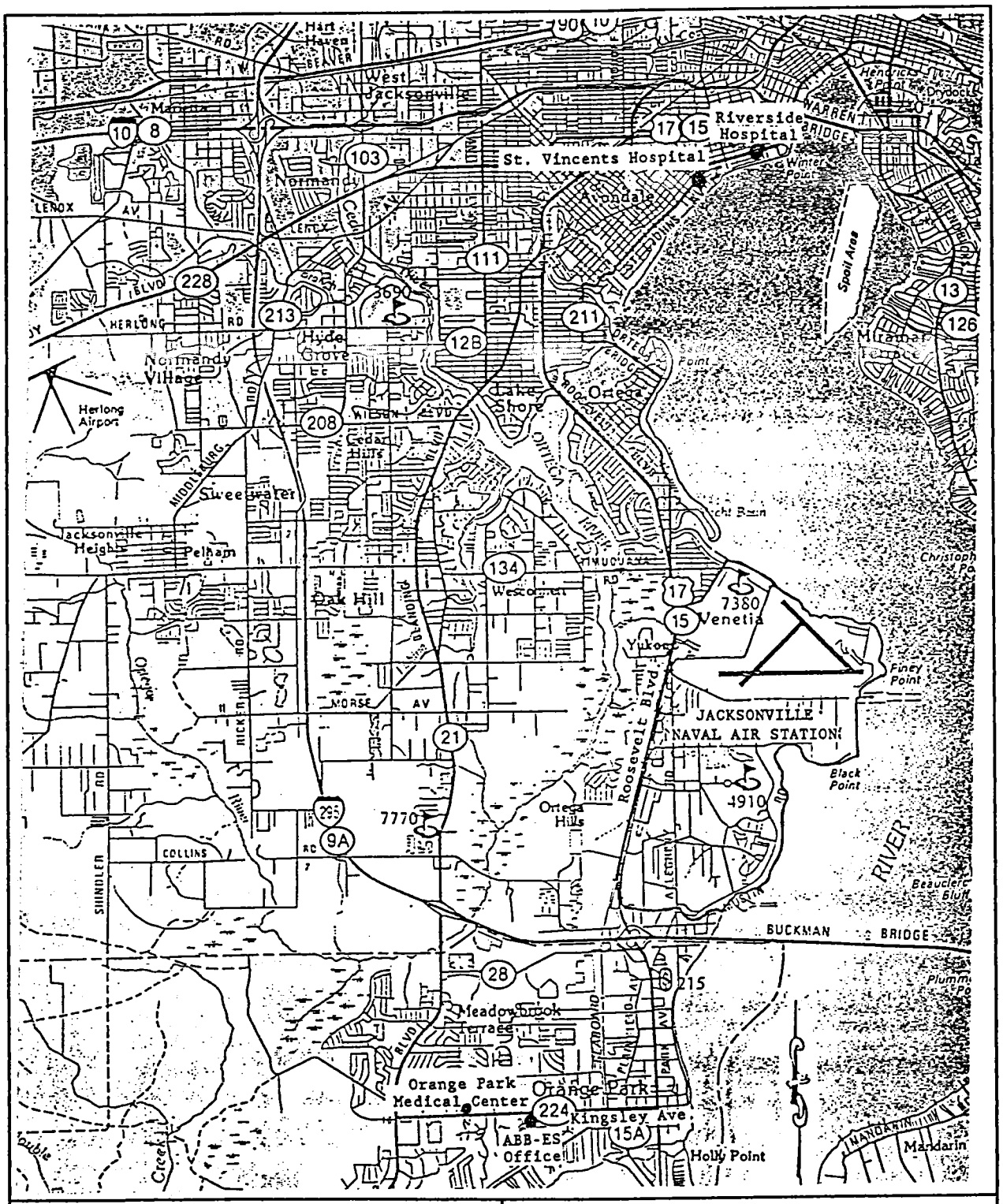

FIGURE 6-1
ROUTES TO HOSPITALS

HEALTH AND SAFETY PLAN FOR OU3

NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

APPENDIX N.1

CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM (CHRIS) DATA SHEETS

BENZENE

BNZ

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Benzol Benzole	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.
IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water.
[illegible]

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 16°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 = 288.8°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 10⁵ J/kg
12.13 Heat of Combustion: −17,460 Btu/lb = −9688 cal/g = −406.0 X 10⁵ 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

BNZ	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

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 or containment
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: 6.0/1888
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 16°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 = 2.483×10^5 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: Not pertinent
12.25 Heat of Fusion: 17.62 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 6.38 psia

NOTES

CRF	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

1,1-DICHLOROETHANE

DCH

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

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:** 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-O-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 = 5.066 MN/m²
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 X 10⁵ J/kg
12.13 **Heat of Combustion:** −4,774 Btu/lb = −2,652 cal/g = −111 X 10⁵ 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

DCH	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

1,2-DICHLOROETHYLENE

DEL

Common Synonyms			
Acetylene dichloride sym-dichloroethylene Dioform cis-1, 2-dichloroethylene trans-1, 2-dichloroethylene	Liquid	Colorless	Sweet pleasant odor

Sinks in water. Flammable, irritating vapor is produced.

Wear goggles and self-contained breathing apparatus.
Shut off ignition sources. Call fire department.
Stop discharge if possible. Keep people away.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Containers may explode in fire.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.

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

Exposure

CALL FOR MEDICAL AID

VAPOR
If inhaled will cause dizziness, nausea, vomiting, or difficult breathing.

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

LIQUID
Harmful if swallowed.

IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

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-high flammability
Restrict access
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: Not listed
3.2 Formula: $ClCH = CHCl$
3.3 IMO/UN Designation: 3.2/1150
3.4 DOT ID No.: 1150
3.5 CAS Registry No.: 540-59-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal, slightly acrid; pleasant, chloroform-like

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves; safety goggles; air supply mask or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, tremor, epigastric cramps, central nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis.
5.3 Treatment of Exposure: INHALATION: remove from further exposure; if breathing is difficult, give oxygen; if victim is not breathing, give artificial respiration, preferably mouth-to-mouth; give oxygen when breathing is resumed; call a physician. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water. INGESTION: give gastric lavage and cathartics.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; oral LD_{50} = 770 mg/kg (rat)
5.7 Late Toxicity: Produces liver and kidney injury in experimental animals
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: 4,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 37°F C.C.
6.2 Flammable Limits in Air: 9.7%-12.8%
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: Phosgene and hydrogen chloride fumes may form in fires.
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: 860°F
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: 2.6 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: Will not occur under ordinary conditions of shipment. The reaction is not vigorous.
7.6 Inhibitor of Polymerization: None used
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: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
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: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classifications

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 16°C and 1 atm: Liquid
12.2 Molecular Weight: 97.0
12.3 Boiling Point at 1 atm:
cis: 140°F = 60°C = 333°K
trans: 118°F = 48°C = 321°K
12.4 Freezing Point:
cis: −114°F = −81°C = 192°K
trans: −58°F = −50°C = 223°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity:
1.27 at 25°C (liquid)
12.8 Liquid Surface Tension:
24 dynes/cm = 0.024 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.)
30 dynes/cm = 0.030 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 3.34
12.11 Ratio of Specific Heats of Vapor (Gas): 1.1488
12.12 Latent Heat of Vaporization:
130 Btu/lb = 72 cal/g =
3.0×10^5 J/kg
12.13 Heat of Combustion: −4,847.2 Btu/lb = −2,692.9 cal/g = -112.67×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.35 Heat of Fusion: Data not available
12.36 Limiting Value: Data not available
12.37 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

DEL

1,2-DICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	81.020
40	80.820
45	80.610
50	80.400
55	80.190
60	79.980
65	79.780
70	79.570
75	79.360
80	79.150
85	78.940
90	78.740
95	78.530
100	78.320
105	78.110
110	77.900
115	77.690
120	77.490
125	77.280
130	77.070
135	76.860
140	76.650

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.193
40	.196
45	.198
50	.200
55	.202
60	.204
65	.207
70	.209
75	.211
80	.213
85	.216
90	.218
95	.220
100	.222
105	.224
110	.227
115	.229
120	.231
125	.233
130	.236
135	.238
140	.240

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
65	.907
70	.894
75	.882
80	.869
85	.857
90	.844
95	.832
100	.819
105	.807
110	.794
115	.782
120	.769
125	.757
130	.744

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
40	.478
50	.454
60	.432
70	.411
80	.393
90	.376
100	.360
110	.345
120	.331
130	.319
140	.307
150	.296
160	.286
170	.276
180	.267
190	.259
200	.251
210	.244

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68	.630

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
55	3.009
60	3.396
65	3.824
70	4.297
75	4.817
80	5.389
85	6.016
90	6.702
95	7.453
100	8.272
105	9.164
110	10.130
115	11.190
120	12.330
125	13.560
130	14.900
135	16.340
140	17.890

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
55	.05284
60	.05906
65	.06587
70	.07330
75	.08141
80	.09023
85	.09980
90	.11020
95	.12140
100	.13360
105	.14680
110	.16070
115	.17590
120	.19220
125	.20960
130	.22830
135	.24820
140	.26960

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.150
20	.153
40	.156
60	.159
80	.162
100	.165
120	.167
140	.170
160	.173
180	.176
200	.179
220	.182
240	.185
260	.188
280	.191
300	.194
320	.197
340	.200
360	.203
380	.206
400	.208
420	.211
440	.214

DICHLOROMETHANE

DCM

Common Synonyms	Watery liquid	Colorless	Sweet, pleasant odor
Methylene chloride Methylene dichloride	Sinks in water. Irritating vapor is produced.		

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

Fire

Not flammable.
POISONOUS GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea and dizziness.
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.
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)

Disperse and flush

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_2Cl_2
3.3 IMO/UN Designation: 9.0/1593
3.4 DOT ID No.: 1593
3.5 CAS Registry No.: 75-09-2

4. OBSERVABLE CHARACTERISTICS

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

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor canister mask, safety glasses, protective clothing.
5.2 Symptoms Following Exposure: INHALATION: anesthetic effects, nausea and drunkenness. CONTACT WITH SKIN AND EYES: skin irritation, irritation of eyes and nose.
5.3 Treatment of Exposure: INHALATION: remove from exposure. Give oxygen if needed. INGESTION: no specific antidote. CONTACT WITH SKIN AND EYES: remove contaminated clothing; wash skin or eyes if affected.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 30 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: 5,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable under conditions likely to be encountered.
6.2 Flammable Limits in Air: 12%-19%
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: Dissociation products generated in a fire may be irritating or toxic.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 1184°F
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: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity: Not pertinent
8.2 Waterfowl Toxicity: Not pertinent
8.3 Biological Oxygen Demand (BOD): Not pertinent
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Aerosol grade; technical grade
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Inerted
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-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	2
Aquatic Toxicity	1
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 NFPA Hazard Classification:

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 84.93
12.3 Boiling Point at 1 atm: 104°F = 39.8°C = 313.0°K
12.4 Freezing Point: −142°F = −96.7°C = 176.5°K
12.5 Critical Temperature: 473°F = 245°C = 518°K
12.6 Critical Pressure: 895 psia = 60.9 atm = 6.17 MN/m²
12.7 Specific Gravity: 1.322 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: 2.9
12.11 Ratio of Specific Heats of Vapor (Gas): 1.199
12.12 Latent Heat of Vaporization: 142 Btu/lb = 78.7 cal/g = 3.30×10^5 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: Not pertinent
12.25 Heat of Fusion: 16.89 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 13.9 psia

NOTES

DCM	DICHLOROMETHANE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—70	91.320
—60	90.700
—50	90.080
—40	89.450
—30	88.830
—20	88.200
—10	87.580
0	86.959
10	86.330
20	85.709
30	85.080
40	84.459
50	83.830
60	83.209
70	82.589
80	81.959
90	81.341
100	80.709

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
35	.274
40	.275
45	.276
50	.277
55	.278
60	.279
65	.279
70	.280
75	.281
80	.282
85	.283
90	.284
95	.284
100	.285

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
—110	1.205
—100	1.192
—90	1.179
—80	1.166
—70	1.154
—60	1.141
—50	1.128
—40	1.115
—30	1.102
—20	1.090
—10	1.077
0	1.064
10	1.051
20	1.038
30	1.025
40	1.013
50	1.000
60	.987
70	.974
80	.961

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	1.380

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
—10	.866
—5	1.013
0	1.180
5	1.370
10	1.586
15	1.830
20	2.105
25	2.414
30	2.762
35	3.151
40	3.585
45	4.068
50	4.606
55	5.201
60	5.860
65	6.588
70	7.389
75	8.270
80	9.237
85	10.300

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
—10	.01525
—5	.01763
0	.02031
5	.02333
10	.02671
15	.03050
20	.03472
25	.03941
30	.04462
35	.05039
40	.05676
45	.06378
50	.07149
55	.07996
60	.08922
65	.09934
70	.11040
75	.12240
80	.13540
85	.14960

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.126
10	.129
20	.131
30	.133
40	.135
50	.137
60	.139
70	.142
80	.144
90	.145
100	.147
110	.149
120	.151
130	.153
140	.155
150	.156
160	.158
170	.159
180	.161
190	.163
200	.164
210	.165
220	.167
230	.168
240	.169
250	.171

ETHYL CHLORIDE

ECL

Common Synonyms	Liquid	Colorless	Pleasant odor
Chloroethane Ether, hydrochloric Monochloroethane	Floats and may boil on water. Flammable, irritating vapor is produced. Boiling point is 54°F.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Avoid contact with liquid.
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.
Stop flow of gas or liquid if possible.
Cool exposed containers and men effecting shutoff with water.
Let fire burn.

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.
Will cause frostbite.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
DO NOT RUB AFFECTED AREAS.

Water Pollution

Not harmful to aquatic life.
May be dangerous if it enters water intakes.
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: Halogenated hydrocarbon
3.2 Formula: C_2H_5Cl
3.3 IMO/UN Designation: 2.0/1037
3.4 DOT ID No.: 1037
3.5 CAS Registry No.: 75-00-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal; pungent, ethereal; ether-like

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Neoprene rubber clothing where liquid contact is likely; chemical worker's goggles. RESPIRATORY PROTECTION: for 1000 ppm to 2% for 1/2 hr or less, full face mask and organic vapor canister; for greater levels, self-contained breathing apparatus or equivalent.
5.2 Symptoms Following Exposure: Vapor causes drunkenness, anesthesia, possible lung injury. Liquid may cause frostbite on eyes and skin.
5.3 Treatment of Exposure: INHALATION: get person to fresh air, keep warm and quiet. Get medical attention. SKIN: treat frostbite.
5.4 Threshold Limit Value: 1000 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Not pertinent
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: 20,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: -58°F C.C. -45°F O.C.
6.2 Flammable Limits in Air: 3.8%-12%
6.3 Fire Extinguishing Agents: Water fog, carbon dioxide, dry chemical. For large fires it is best to allow material to burn while cooling surrounding equipment. Stop flow of ethyl chloride.
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: Containers may explode.
6.7 Ignition Temperature: 966°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 3.8 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: 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: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical: 99-100%; USP: 100%
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 liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

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

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	4
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 16°C and 1 atm: Gas
12.2 Molecular Weight: 64.52
12.3 Boiling Point at 1 atm: 54.0°F = 12.2°C = 285.4°K
12.4 Freezing Point: —213°F = —136°C = 137°K
12.5 Critical Temperature: 369°F = 187.2°C = 460.4°K
12.6 Critical Pressure: 756 psia = 51.6 atm = 5.23 MN/m2
12.7 Specific Gravity: 0.906 at 12.2°C (liquid)
12.8 Liquid Surface Tension: 19.5 dynes/cm = 0.0195 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 40 dynes/cm = 0.04 N/m at 0°C
12.10 Vapor (Gas) Specific Gravity: 2.2
12.11 Ratio of Specific Heats of Vapor (Gas): 1.155
12.12 Latent Heat of Vaporization: 163 Btu/lb = 90.8 cal/g = 3.79 X 10^5 J/kg
12.13 Heat of Combustion: —8100 Btu/lb = —4500 cal/g = —188.4 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: 16.49 cal/g
12.26 Limiting Value: Data Not Available
12.27 Reid Vapor Pressure: 34.5 psia

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: 6.383 (Est.)
6.12 Flame Temperature: Data Not Available

ECL	ETHYL CHLORIDE

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
	DATA NOT AVAILABLE	—20	.299	28	.880	15	.364
		—15	.305	30	.878	20	.354
		—10	.312	32	.876	25	.345
		—5	.319	34	.875	30	.336
		0	.325	36	.873	35	.328
		5	.332	38	.871	40	.320
		10	.339	40	.869	45	.312
		15	.345	42	.868	50	.305
		20	.352	44	.866		
		25	.359	46	.864		
		30	.365	48	.863		
		35	.372	50	.861		
		40	.379	52	.859		
		45	.385	54	.858		
		50	.392				

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
68.02	.600	—35	1.419	—35	.02008	0	.207
		—30	1.659	—30	.02320	25	.215
		—25	1.932	—25	.02671	50	.223
		—20	2.242	—20	.03065	75	.231
		—15	2.594	—15	.03506	100	.239
		—10	2.991	—10	.03997	125	.247
		—5	3.438	—5	.04544	150	.254
		0	3.939	0	.05151	175	.262
		5	4.501	5	.05822	200	.269
		10	5.129	10	.06563	225	.277
		15	5.828	15	.07379	250	.284
		20	6.604	20	.08275	275	.291
		25	7.465	25	.09257	300	.298
		30	8.416	30	.10330	325	.305
		35	9.466	35	.11500	350	.311
		40	10.620	40	.12780	375	.318
		45	11.890	45	.14160	400	.324
		50	13.280	50	.15670	425	.331
		55	14.810	55	.17290	450	.337
		60	16.470	60	.19050	475	.343
		65	18.290	65	.20950	500	.349
		70	20.260	70	.22990	525	.355
		75	22.400	75	.25180	550	.360
		80	24.730	80	.27540	575	.366
		85	27.240	85	.30060	600	.372

ETHYLENE DICHLORIDE

EDC

Common Synonyms	Liquid	Colorless	Sweet odor
1, 2-Dichloroethane Ethylene chloride EDC Brocide Dutch liquid Glycol dichloride	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.
POISONOUS GASES ARE PRODUCED IN FIRE.
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 nausea, 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 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
Disperse and flush

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: $ClCH_2CH_2Cl$
3.3 IMO/UN Designation: 3.2/1184
3.4 DOT ID No.: 1184
3.5 CAS Registry No.: 107-06-2

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal; chloroform-like; ether-like

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Clean, body-covering clothing and safety glasses with side shields. Respiratory protection: up to 50 ppm, none; 50 ppm to 2%, 1/2 hr or less, full face mask and canister; greater than 2%, self-contained breathing apparatus.
5.2 Symptoms Following Exposure: Inhalation of vapors causes nausea, drunkenness, depression. Contact of liquid with eyes may produce corneal injury. Prolonged contact with skin may cause a burn.
5.3 Treatment of Exposure: INHALATION: If victim is overcome, remove him to fresh air, keep him quiet and warm, and get medical attention immediately; if breathing stops, give artificial respiration. INGESTION: Induce vomiting; call a physician; treat the symptoms. EYES: flush immediately with copious amounts of flowing water for at least 15 min. SKIN: remove clothing and wash skin thoroughly with soap and water; wash contaminated clothing before reuse.
5.4 Threshold Limit Value: 10 ppm
5.5 Short Term Inhalation Limits: 200 ppm for 5 min. during any 3-hour period.
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: 100 ppm
5.11 IDLH Value: 1,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 60°F O.C.; 56°F C.C.
6.2 Flammable Limits in Air: 6.2%-15.6%
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: Toxic and irritating gases (hydrogen chloride, phosgene) are generated.
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: 775°F
6.8 Electrical Hazard: Class I, group D
6.9 Burning Rate: 1.6 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: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity: 150 ppm/*/pin perch/TL_m/salt water
*Time period not specified.
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0.002 lb/lb, 5 days
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: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X

11. HAZARD CLASSIFICATIONS

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

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

11.3 NFPA Hazard Classifications

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 16°C and 1 atm: Liquid
12.2 Molecular Weight: 98.96
12.3 Boiling Point at 1 atm: 182.3°F = 83.5°C = 356.7°K
12.4 Freezing Point: −32.3°F = −36.7°C = 237.5°K
12.5 Critical Temperature: 550°F = 288°C = 561°K
12.6 Critical Pressure: 735 psia = 50 atm = 5.1 MN/m²
12.7 Specific Gravity: 1.253 at 20°C (liquid)
12.8 Liquid Surface Tension: 32.2 dynes/cm = 0.0322 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.03 N/m at 25°C
12.10 Vapor (Gas) Specific Gravity: 3.4
12.11 Ratio of Specific Heats of Vapor (Gas): 1.118
12.12 Latent Heat of Vaporization: 138 Btu/lb = 76.4 cal/g = 3.2×10^5 J/kg
12.13 Heat of Combustion: (est.) 3400 Btu/lb
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: 21.12 cal/g
12.26 Limiting Value: Data Not Available
12.27 Reid Vapor Pressure: 2.7 psia

6. FIRE HAZARDS (Continued)

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

EDC	ETHYLENE DICHLORIDE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	79.879
40	79.629
45	79.379
50	79.129
55	78.879
60	78.620
65	78.370
70	78.120
75	77.860
80	77.599
85	77.349
90	77.089
95	76.830
100	76.570
105	76.309
110	76.049
115	75.790
120	75.520
125	75.259
130	74.990
135	74.730
140	74.459
145	74.190
150	73.919
155	73.660
160	73.379

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.283
10	.285
20	.288
30	.290
40	.293
50	.296
60	.298
70	.301
80	.303
90	.306
100	.309
110	.311
120	.314
130	.317
140	.319
150	.322
160	.324
170	.327

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
0	.990
10	.982
20	.974
30	.965
40	.957
50	.949
60	.941
70	.933
80	.924
90	.916
100	.908
110	.900
120	.892
130	.883
140	.875
150	.867
160	.859
170	.850

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
35	1.098
40	1.054
45	1.013
50	.975
55	.938
60	.904
65	.871
70	.840
75	.811
80	.784
85	.758
90	.733
95	.709
100	.687
105	.665
110	.645
115	.625
120	.607
125	.589
130	.573
135	.556
140	.541
145	.526
150	.512
155	.499
160	.486

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.800

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
15	.231
20	.274
25	.323
30	.380
35	.445
40	.520
45	.606
50	.704
55	.816
60	.942
65	1.085
70	1.246
75	1.428
80	1.632
85	1.860
90	2.116
95	2.401
100	2.718

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
15	.00449
20	.00526
25	.00614
30	.00715
35	.00830
40	.00960
45	.01106
50	.01274
55	.01461
60	.01671
65	.01907
70	.02169
75	.02462
80	.02788
85	.03149
90	.03548
95	.03990
100	.04477

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.177
25	.182
50	.187
75	.191
100	.195
125	.200
150	.204
175	.208
200	.212
225	.217
250	.221
275	.225
300	.229
325	.232
350	.236
375	.240
400	.244
425	.247
450	.251
475	.254
500	.258
525	.261
550	.265
575	.268
600	.271

METHYL ETHYL KETONE

MEK

Common Synonyms
MEK
2-Butanone
Ethyl methyl ketone

Liquid — Colorless — Sweet odor

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.
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, 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 is difficult, give oxygen.

LIQUID
Will burn 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

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
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: $CH_3COCH_2CH_3$
3.3 IMO/UN Designation: 3.2/1193
3.4 DOT ID No.: 1193
3.5 CAS Registry No.: 78-93-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like acetone; pleasant; pungent

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic canister or air pack; plastic gloves; goggles or face shield.
5.2 Symptoms Following Exposure: Liquid causes eye burn. Vapor irritates eyes, nose, and throat; can cause headache, dizziness, nausea, weakness, and loss of consciousness.
5.3 Treatment of Exposure: INHALATION: remove victim to fresh air; if breathing is irregular or has stopped, start resuscitation and administer oxygen. EYES: wash with plenty of water for at least 15 min. and call physician.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: 290 mg/m³ 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: 10 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 20°F C.C.; 22°F O.C.
6.2 Flammable Limits in Air: 1.8%-11.5%
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: Not pertinent
6.7 Ignition Temperature: 961°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4.1 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: 5640 mg/l/48 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 214%, 5 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) 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	2
Aquatic Toxicity	1
Aesthetic Effect	1
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	0

11.3 NFPA Hazard Classifications:

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: 72.11
12.3 Boiling Point at 1 atm: 175.3°F = 79.6°C = 352.8°K
12.4 Freezing Point: −123.3°F = −86.3°C = 186.9°K
12.5 Critical Temperature: 504.5°F = 262.5°C = 536.7°K
12.6 Critical Pressure: 603 psia = 41.0 atm = 4.15 MN/m²
12.7 Specific Gravity: 0.806 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: 2.5
12.11 Ratio of Specific Heats of Vapor (Gas): 1.075
12.12 Latent Heat of Vaporization: 191 Btu/lb = 106 cal/g = 4.44 X 10⁵ J/kg
12.13 Heat of Combustion: −13,480 Btu/lb = −7491 cal/g = −313.6 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution (est.): −9 Btu/lb = −5 cal/g = −0.2 X 10⁵ 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: 3.5 psia

NOTES

MEK	METHYL ETHYL KETONE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	51.460
40	51.280
45	51.110
50	50.940
55	50.760
60	50.590
65	50.420
70	50.240
75	50.070
80	49.900
85	49.720
90	49.550
95	49.380
100	49.200
105	49.030
110	48.860
115	48.680
120	48.510

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
—35	.501
—30	.502
—25	.503
—20	.504
—15	.505
—10	.507
—5	.508
0	.509
5	.510
10	.511
15	.512
20	.513
25	.514
30	.516
35	.517
40	.518
45	.519
50	.520
55	.521
60	.522
65	.523
70	.524
75	.526
80	.527
85	.528
90	.529

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
10	1.073
15	1.068
20	1.063
25	1.058
30	1.053
35	1.048
40	1.043
45	1.038
50	1.033
55	1.028
60	1.023
65	1.018
70	1.013
75	1.008
80	1.003
85	.998
90	.993
95	.988
100	.983
105	.978

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	27.000

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
0	.148
10	.216
20	.310
30	.437
40	.604
50	.823
60	1.104
70	1.461
80	1.909
90	2.465
100	3.147
110	3.977
120	4.977
130	6.171
140	7.586
150	9.250
160	11.190
170	13.450
180	16.050
190	19.030
200	22.420
210	26.270
220	30.610
230	35.480
240	40.930

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
0	.00216
10	.00310
20	.00435
30	.00599
40	.00812
50	.01085
60	.01427
70	.01853
80	.02376
90	.03012
100	.03778
110	.04690
120	.05768
130	.07030
140	.08496
150	.10190
160	.12130
170	.14350
180	.16850
190	.19670
200	.22830
210	.26350
220	.30250
230	.34560
240	.39290

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.352
25	.368
50	.384
75	.399
100	.414
125	.429
150	.444
175	.458
200	.472
225	.486
250	.500
275	.513
300	.526
325	.538
350	.551
375	.563
400	.575
425	.586
450	.598
475	.609
500	.620
525	.630
550	.640
575	.650
600	.660

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.		

[illegible] if possible. [illegible] people away
[illegible] and remove discharged material
[illegible] health and pollution control agencies

9

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

Exposure

[illegible]

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or loss of consciousness.
[illegible] artificial respiration
[illegible] oxygen

LIQUID
Irritating to skin and eyes
Harmful if swallowed.
[illegible] contaminated clothing and shoes
[illegible] areas with plenty of water
[illegible] eyelids open and flush with plenty of water
[illegible] victim is conscious, have victim drink water
[illegible]

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.
[illegible] 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.) 1.6%, 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 10⁵ J/kg
12.13 Heat of Combustion: (est.) −10,400 Btu/lb = −5,800 cal/g = −242 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: (est.) −9 Btu/lb = −5 cal/g = −0.2 X 10⁵ 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

TETRACHLOROETHYLENE

TTE

Common Synonyms	Watery liquid	Colorless	Sweet odor
Tetracap Perclene Perchloroethylene Perk	Sinks in water. Irritating vapor is produced.		

[illegible] personnel
[illegible] contact with liquid and vapor
[illegible] and remove discharged material
[illegible] health and pollution control agencies

Fire	Not flammable. Poisonous gases are produced when heated.
Exposure	[illegible] MEDICAL [illegible] **VAPOR** Irritating to eyes, nose and throat. If inhaled, will cause difficult breathing, or loss of consciousness. [illegible] **LIQUID** Irritating to skin and eyes. Harmful if swallowed. [illegible] contaminated clothing and shoes [illegible] affected areas with plenty of water [illegible] EYES and skin with plenty of water [illegible] SWALLOWED and victim is conscious, [illegible] with lots of water
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: Not listed

3.2 Formula: $Cl_2C=CCl_2$

3.3 IMO/UN Designation: 9.0/1897

3.4 DOT ID No.: 1897

3.5 CAS Registry No.: 127-18-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid

4.2 Color: Colorless

4.3 Odor: Ethereal; like chloroform; mildly sweet

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: For high vapor concentrations use approved canister or air-supplied mask; chemical goggles or face shield; plastic gloves.

5.2 Symptoms Following Exposure: Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury.

5.3 Treatment of Exposure: INHALATION: If illness occurs, remove patient to fresh air, keep him warm and quiet, and get medical attention. INGESTION: induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs.

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

5.7 Late Toxicity: None

5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or throat 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: 5 ppm

5.11 IDLH Value: 500 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, irritating gases may be generated in fires.

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: 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: Dry cleaning and industrial grades: 95+%

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

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A

11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	0
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	1

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: 165.83

12.3 Boiling Point at 1 atm: 250°F = 121°C = 394°K

12.4 Freezing Point: −8.3°F = −22.4°C = 250.8°K

12.5 Critical Temperature: 657°F = 347°C = 620°K

12.6 Critical Pressure: Not pertinent

12.7 Specific Gravity: 1.63 at 20°C (liquid)

12.8 Liquid Surface Tension: 31.3 dynes/cm = 0.0313 N/m at 20°C

12.9 Liquid Water Interfacial Tension: 44.4 dynes/cm = 0.0444 N/m at 25°C

12.10 Vapor (Gas) Specific Gravity: Not pertinent

12.11 Ratio of Specific Heats of Vapor (Gas): 1.116

12.12 Latent Heat of Vaporization: 90.2 Btu/lb = 50.1 cal/g = 2.10×10^5 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: 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

TTE	TETRACHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
35	103.400
40	103.099
45	102.900
50	102.599
55	102.299
60	102.000
65	101.700
70	101.400
75	101.099
80	100.799
85	100.500
90	100.200
95	99.910
100	99.610
105	99.320
110	99.020
115	98.730
120	98.429
125	98.139
130	97.839
135	97.549
140	97.250
145	96.959
150	96.669
155	96.370
160	96.080

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.198
10	.200
20	.201
30	.202
40	.203
50	.204
60	.205
70	.206
80	.207
90	.208
100	.210
110	.211
120	.212
130	.213
140	.214
150	.215
160	.216
170	.217
180	.218
190	.220
200	.221
210	.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
55	.958
60	.929
65	.900
70	.873
75	.848
80	.823
85	.800
90	.777
95	.756
100	.736
105	.716
110	.698
115	.680
120	.663
125	.647
130	.631
135	.616
140	.601
145	.588
150	.574
155	.561
160	.549
165	.537
170	.526
175	.515

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.016

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
60	.236
70	.318
80	.425
90	.561
100	.732
110	.948
120	1.217
130	1.548
140	1.953
150	2.446
160	3.042
170	3.756
180	4.607
190	5.616
200	6.805
210	8.199
220	9.824
230	11.710
240	13.890
250	16.390
260	19.260
270	22.520
280	26.230

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	.00702
70	.00929
80	.01216
90	.01575
100	.02022
110	.02571
120	.03242
130	.04055
140	.05032
150	.06199
160	.07583
170	09215
180	.11130
190	.13360
200	.15940
210	.18910
220	.22330
230	.26230
240	.30660
250	.35680
260	.41330
270	.47680
280	.54790

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.108
25	.110
50	.113
75	.116
100	.118
125	.120
150	.122
175	.125
200	.127
225	.129
250	.131
275	.132
300	.134
325	.136
350	.138
375	.139
400	.141
425	.142
450	.143
475	.144
500	.146
525	.147
550	.148
575	.148
600	.149

TOLUENE

TOL

Common Synonyms

Toluol
Methylbenzene
Methylbenzol

Watery liquid — Colorless — Pleasant 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.
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), 6 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/m²
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 10⁵ J/kg
12.13 Heat of Combustion: −17,430 Btu/lb = −9688 cal/g = −405.5 X 10⁵ 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

TOL	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	.331
225	.343
250	.355
275	.367
300	.378
325	.389
350	.400
375	.411
400	.422
425	.432
450	.443
475	.453
500	.462
525	.472
550	.482
575	.491
600	.500

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: <−35°F = <−37°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 = 56 cal/g = 2.4 X 10^5 J/kg
12.13 Heat of Combustion: (est.) 4700 Btu/lb = 2600 cal/g = 110 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
12.26 Heat of Fusion: Data not available
12.28 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 4.0 psia

NOTES

TCE	TRICHLOROETHANE

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
0	85.419	55	.240		N	15	1.363
10	84.870	60	.242		O	20	1.295
20	84.309	65	.244		T	25	1.231
30	83.759	70	.246			30	1.172
40	83.200	75	.248		P	35	1.117
50	82.650	80	.250		E	40	1.065
60	82.089	85	.252		R	45	1.017
70	81.540	90	.254		T	50	.972
80	80.981	95	.256		I	55	.929
90	80.429	100	.258		N	60	.889
100	79.870	105	.260		E	65	.852
110	79.320	110	.262		N	70	.817
120	78.759	115	.264		T	75	.784
130	78.209	120	.266			80	.753
140	77.650	125	.268			85	.723
150	77.099	130	.270				
160	76.540	135	.272				
		140	.274				

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
68.02	.070	70	2.099	70	.04925	0	.146
		75	2.364	75	.05495	25	.150
		80	2.657	80	.06119	50	.155
		85	2.980	85	.06799	75	.159
		90	3.335	90	.07540	100	.163
		95	3.725	95	.08346	125	.167
		100	4.152	100	.09220	150	.171
		105	4.619	105	.10170	175	.175
		110	5.130	110	.11190	200	.179
		115	5.686	115	.12300	225	.183
		120	6.292	120	.13490	250	.186
		125	6.950	125	.14770	275	.190
		130	7.663	130	.16150	300	.193
		135	8.437	135	.17630	325	.196
		140	9.273	140	.19220	350	.199
		145	10.180	145	.20920	375	.202
		150	11.150	150	.22730	400	.205
		155	12.200	155	.24670	425	.208
		160	13.330	160	.26730	450	.210
		165	14.540	165	.28930	475	.213
		170	15.840	170	.31270	500	.215
		175	17.240	175	.33760	525	.217
		180	18.730	180	.36390	550	.219
		185	20.330	185	.39180	575	.222
		190	22.030	190	.42140	600	.223

TRICHLOROETHYLENE

TCL

Common Synonyms

Trichloroethylene
Trichlene; Algylen
Chlorylen
Gemalgene
Trethylene
Trichloran; Triene

Watery liquid — Colorless — Sweet odor

Sinks in water. Irritating vapor is produced.

...ce discharge if possible. Keep people away.
...void contact with liquid and vapor.
...all fire department.
...olate and remove discharged material.
...otify 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 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
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, difficult breathing, 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)
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: $CHCl=CCl_2$
3.3 IMO/UN Designation: 6.0/1710
3.4 DOT ID No.: 1710
3.5 CAS Registry No.: 79-01-6

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (at shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Chloroform-like; ethereal

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or vinyl gloves; chemical safety goggles; face-shield; neoprene safety shoes; neoprene suit or apron for splash protection.
5.2 Symptoms Following Exposure: INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to inhalation. SKIN: defatting action can cause dermatitis. EYES: slightly irritating sensation and lachrymation.
5.3 Treatment of Exposure: Do NOT administer adrenalin or ephedrine; get medical attention for all cases of overexposure. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting; repeat three times; then give 1 tablespoon epsom salts in water. EYES: flush thoroughly with water. SKIN: wash thoroughly with soap and warm water.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 200 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/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: 50 ppm
5.11 IDLH Value: 1,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 90°F C.C.; practically nonflammable
6.2 Flammable Limits in Air: 8.0%-10.5%
6.3 Fire Extinguishing Agents: Water fog
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic and irritating gases are produced in fire situations.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 770°F
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: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity: 560 mg/l/40 hr/daphnia/bill/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: Technical; dry cleaning; degreasing; extraction
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	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	1

11.3 NFPA Hazard Classifications:

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 16°C and 1 atm: Liquid
12.2 Molecular Weight: 131.39
12.3 Boiling Point at 1 atm: 189°F = 87°C = 360°K
12.4 Freezing Point: −123.8°F = −86.4°C = 186.8°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.46 at 20°C (liquid)
12.8 Liquid Surface Tension: 29.3 dynes/cm = 0.0293 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 34.5 dynes/cm = 0.0345 N/m at 24°C
12.10 Vapor (Gas) Specific Gravity: 4.5
12.11 Ratio of Specific Heats of Vapor (Gas): 1.116
12.12 Latent Heat of Vaporization: 103 Btu/lb = 57.2 cal/g = 2.4 X 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: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 2.5 psia

NOTES

TCL	TRICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
0	94.669
5	94.410
10	94.150
15	93.889
20	93.629
25	93.370
30	93.110
35	92.849
40	92.589
45	92.330
50	92.070
55	91.809
60	91.549
65	91.290
70	91.030
75	90.770
80	90.509
85	90.250
90	89.990
95	89.730
100	89.469
105	89.209
110	88.950
115	88.690
120	88.429
125	88.169

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.220
10	.221
20	.223
30	.225
40	.226
50	.228
60	.230
70	.231
80	.233
90	.235
100	.236
110	.238
120	.240
130	.241
140	.243
150	.245
160	.246
170	248

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	.800
20	.775
25	.750
30	.727
35	.705
40	.684
45	.664
50	.645
55	.627
60	.610
65	.593
70	.577
75	.562
80	.548
85	.534
90	.521
95	.508
100	.496
105	.485
110	.474
115	.463
120	.453

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
40	.508
50	.678
60	.894
70	1.166
80	1.507
90	1.929
100	2.448
110	3.081
120	3.846
130	4.765
140	5.862
150	7.163
160	8.695
170	10.490
180	12.580
190	15.010
200	17.810
210	21.020

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
40	.01245
50	.01628
60	.02105
70	.02695
80	.03418
90	.04296
100	.05354
110	.06619
120	.08120
130	.09891
140	.11960
150	.14380
160	.17180
170	.20390
180	.24080
190	.28280
200	.33040
210	.38420

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.136
25	.139
50	.143
75	.146
100	.149
125	.152
150	.155
175	.157
200	.160
225	.162
250	.165
275	.167
300	.169
325	.172
350	.174
375	.176
400	.177
425	.179
450	.181
475	.182
500	.184
525	.185
550	.186
575	.187
600	.188

VINYL CHLORIDE

VCM

Common Synonyms			
Chloroethylene VCL Vinyl C Monomer VCM	Gas	Colorless	Sweet odor

Liquid floats and boils on water. Flammable, irritating 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.
Evacuate area in case of large discharge.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
POISONOUS GAS IS PRODUCED IN FIRE.
Flashback along vapor trail may occur.
May explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Cool exposed containers and protect men effecting shutoff with water.
Stop flow of gas if possible.
Let fire burn.
Extinguish small fires with dry chemical.

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 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
Evacuate area

2. LABEL

2.1 Category: Flammable gas
2.2 Class: 2

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Vinyl halides
3.2 Formula: $CH_2{=}CHCl$
3.3 IMO/UN Designation: 2.0/1086
3.4 DOT ID No.: 1086
3.5 CAS Registry No.: 75-01-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquefied compressed gas
4.2 Color: Colorless
4.3 Odor: Pleasant, sweet

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves and shoes; gas-tight goggles; organic vapor canister or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate.
5.3 Treatment of Exposure: INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing.
5.4 Threshold Limit Value: 5 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 5 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: Chronic exposure may cause liver damage.
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 skin. May cause frostbite.
5.10 Odor Threshold: 260 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: —110°F O.C.
6.2 Flammable Limits in Air: 4%-26%
6.3 Fire Extinguishing Agents: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgene, and carbon monoxide.
6.6 Behavior in Fire: Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 882°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4.3 mm/min.

(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: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.
7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 35

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 or technical 99+%
9.2 Storage Temperature: Under pressure: ambient At atm. pressure: low
9.3 Inert Atmosphere: No requirement
9.4 Venting: Under pressure: safety relief At atm. pressure: pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-B-C-D-E-F-G-Z

11. HAZARD CLASSIFICATIONS

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

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

11.3 NFPA Hazard Classifications:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	4
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 62.50
12.3 Boiling Point at 1 atm: 7.2°F = 13.8°C = 256.4°K
12.4 Freezing Point: —244.8°F = —153.8°C = —119.4°K
12.5 Critical Temperature: 317.1°F = 158.4°C = 431.5°K
12.6 Critical Pressure: 775 psia = 52.7 atm = 5.34 MN/m²
12.7 Specific Gravity: 0.969 at —13°C (liquid)
12.8 Liquid Surface Tension: 16.0 dynes/cm = 0.0160 N/m at 25°C
12.9 Liquid Water Interfacial Tension (est.): 30 dynes/cm = 0.03 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.2
12.11 Ratio of Specific Heats of Vapor (Gas): 1.186
12.12 Latent Heat of Vaporization: 160 Btu/lb = 88 cal/g = 3.7 X 10⁵ J/kg
12.13 Heat of Combustion: —8136 Btu/lb = —4520 cal/g = —189.1 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: —729 Btu/lb = —405 cal/g = 16.9 X 10⁵ J/kg
12.25 Heat of Fusion: 16.14 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 75 psia

6. FIRE HAZARDS (Continued)

6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: 5.490 (Est.)
6.12 Flame Temperature: Data not available

VCM	VINYL CHLORIDE

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
0	61.000	—30	.259		NOT PERTINENT	—10	.287
5	60.710	—20	.265			—5	.281
		—10	.272			0	.276
		0	.279			5	.271

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
68.02	.600	—50	3.384	—50	.04810	0	.185
		—40	4.501	—40	.06245	25	.192
		—30	5.908	—30	.08005	50	.198
		—20	7.658	—20	.10140	75	.205
		—10	9.814	—10	.12710	100	.211
		0	12.440	0	.15760	125	.217
		10	15.610	10	.19360	150	.224
		20	19.410	20	.23560	175	.230
		30	23.920	30	.28440	200	.235
		40	29.220	40	.34050	225	.241
		50	35.430	50	.40470	250	.247
		60	42.630	60	.47760	275	.252
		70	50.940	70	.56000	300	.257
		80	60.480	80	.65250	325	.263
		90	71.349	90	.75570	350	.268
		100	83.669	100	.87050	375	.273
		110	97.580	110	.99740	400	.277
		120	113.200	120	1.13700	425	.282
						450	.286
						475	.291
						500	.295
						525	.299
						550	.303
						575	.307
						600	.311

VINYLIDENE CHLORIDE

VCI

Common Synonyms	Watery liquid	Colorless	Sweet odor
1, 1-Dichloroethylene unsym-Dichloroethylene	Sinks in water. Flammable, irritating vapor is produced. Boiling point is 89°F.		

- 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.
- Evacuate area in case of large discharge.
- Isolate and remove discharged materials.
- Notify local health and pollution control agencies.

Fire

FLAMMABLE.
POISONOUS GAS IS PRODUCED IN FIRE.
Containers may explode in fire.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Combat fires from safe distance or protected location.
Extinguish with dry chemical, foam, or carbon dioxide.
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.

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-high flammability
Evacuate area.

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Vinyl halides
3.2 Formula: $CH_2=CCl_2$
3.3 IMO/UN Designation: 3.1/1303
3.4 DOT ID No.: 1303
3.5 CAS Registry No.: 75-35-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Sweet; like carbon tetrachloride or chloroform

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; rubber gloves and boots.
5.2 Symptoms Following Exposure: Vapor can cause dizziness and drunkenness; high levels cause anesthesia. Liquid irritates eyes and skin.
5.3 Treatment of Exposure: INHALATION: if any illness develops, remove person to fresh air promptly, keep warm and quiet, and get medical attention; if breathing stops, start artificial respiration. INGESTION: not likely a problem; no known antidote; treat symptomatically. EYES OR SKIN: flush with plenty of water for at least 15 min; get medical attention for eyes; remove contaminated clothing and wash before reuse.
5.4 Threshold Limit Value: 10 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 3; Oral LD_{50} = 24 hr = 84 mg/kg (adrenalectomized 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 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: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 0°F O.C.
6.2 Flammable Limits in Air: 7.3%-16.0%
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: Toxic hydrogen chloride and phosgene are generated in fires.
6.6 Behavior in Fire: May explode in fire due to polymerization. Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 955—1031°F
6.8 Electrical Hazard: Not pertinent
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: Copper and aluminum can cause polymerization.
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Can occur if exposed to sunlight, air, copper, aluminum, heat.
7.6 Inhibitor of Polymerization: 200 ppm methyl ether of hydroquinone; 0.8-0.8% phenol
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 35

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: 99%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: Padded
9.4 Venting: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y-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	3
Water Pollution	
Human Toxicity	0
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	3

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	4
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 16°C and 1 atm: Liquid
12.2 Molecular Weight: 96.95
12.3 Boiling Point at 1 atm: 88.9°F = 31.6°C = 304.8°K
12.4 Freezing Point: —187.6°F = 122.0°C = 151.2°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.21 at 20°C (liquid)
12.8 Liquid Surface Tension: 24 dynes/cm = 0.024 N/m at 15°C
12.9 Liquid Water Interfacial Tension: 37 dynes/cm = 0.037 N/m at 22.7°C
12.10 Vapor (Gas) Specific Gravity: 3.3
12.11 Ratio of Specific Heats of Vapor (Gas): Data not available
12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0×10^5 J/kg
12.13 Heat of Combustion: —4660 Btu/lb = —2700 cal/g = -113.0×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: —333 Btu/lb = —185 cal/g = -7.75×10^5 J/kg
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 18.3 psia

6. FIRE HAZARDS (Continued)

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

VCI	VINYLIDENE CHLORIDE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
—20	81.450
—15	81.129
—10	80.799
—5	80.469
0	80.139
5	79.809
10	79.480
15	79.150
20	78.820
25	78.490
30	78.160
35	77.830
40	77.500
45	77.169
50	76.839
55	76.509
60	76.179
65	75.849
70	75.520
75	75.200
80	74.870
85	74.540

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.262
10	.268
20	.273
30	.279
40	.284
50	.290
60	.295
70	.301
80	.307

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
—20	.478
—15	.466
—10	.455
—5	.443
0	.433
5	.423
10	.413
15	.404
20	.395
25	.387
30	.378
35	.371
40	.363
45	.356
50	.349
55	.342
60	.336
65	.330
70	.324
75	.318
80	.313
85	.307

12.21 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.500

12.22 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
40	5.115
50	6.473
60	8.108
70	10.060
80	12.360
90	15.070
100	18.220
110	21.870
120	26.060
130	30.850
140	36.290
150	42.430
160	49.340
170	57.070
180	65.669
190	75.209
200	85.750
210	97.339

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
40	.09246
50	.11470
60	.14090
70	.17150
80	.20690
90	.24760
100	.29410
110	.34670
120	.40600
130	.47250
140	.54650
150	.62860
160	.71920
170	.81860
180	.92720
190	1.04600
200	1.17400
210	1.31300

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F (estimate)
100	.169
120	.172
140	.175
160	.178
180	.181
200	.184
220	.186
240	.189
260	.192
280	.194
300	.197
320	.199
340	.202
360	.204
380	.206
400	.209
420	.211
440	.213
460	.215
480	.217
500	.219
520	.221
540	.223
560	.225
580	.227
600	.229

p-XYLENE

XLP

Common Synonyms
1, 4-Dimethylbenzene
Xylol

Watery liquid — Colorless — Sweet odor

Floats on water. Flammable, irritating vapor is produced.
Freezing point is 58°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: 99.5%; 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

Category	Rating
Transportation:	
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: 508.4 atm = 34.65 psia = 3.510 MN/m²
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 X 10⁵ J/kg
12.13 Heat of Combustion: −17,558 Btu/lb = −9754.7 cal/g = −408.41 X 10⁵ 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

XLP	p-XYLENE

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
60	53.970	60	.412	60	.935	60	.678
65	53.830	70	.418	65	.928	65	.654
70	53.690	80	.424	70	.921	70	.631
75	53.550	90	.429	75	.914	75	.610
80	53.410	100	.435	80	.907	80	.590
85	53.270	110	.440	85	.900	85	.571
90	53.140	120	.446	90	.892	90	.552
95	53.000	130	.451	95	.885	95	.535
100	52.860	140	.457	100	.878	100	.519
105	52.720	150	.462			105	.503
110	52.580	160	.468			110	.488
115	52.440	170	.474			115	.474
120	52.300	180	.479			120	.460
		190	.485				
		200	.490				
		210	.496				
		220	.501				
		230	.507				
		240	.512				
		250	.518				
		260	.524				
		270	.529				
		280	.535				

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	.096	60	.00183	0	.246
	N	70	.135	70	.00252	25	.259
	S	80	.187	80	.00343	50	.272
	O	90	.255	90	.00459	75	.285
	L	100	.343	100	.00607	100	.297
	U	110	.456	110	.00792	125	.309
	B	120	.599	120	.01022	150	.321
	L	130	.777	130	.01303	175	.333
	E	140	.998	140	.01646	200	.345
		150	1.270	150	.02059	225	.357
		160	1.600	160	.02553	250	.368
		170	1.998	170	.03138	275	.380
		180	2.475	180	.03826	300	.391
		190	3.041	190	.04629	325	.402
		200	3.710	200	.05561	350	.413
		210	4.493	210	.06636	375	.424
		220	5.407	220	.07867	400	.435
		230	6.465	230	.09270	425	.445
		240	7.683	240	.10860	450	.456
		250	9.080	250	.12650	475	.466
		260	10.670	260	.14670	500	.476
						525	.486
						550	.496
						575	.505
						600	.515

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 shorelines.
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: 867°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.), 5 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 Classifications:

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 pals = 3.732 MN/m²
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): 1.088
12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47 X 10^5 J/kg
12.13 Heat of Combustion: −17,558 Btu/lb = −9754.7 cal/g = −408.41 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: 30.64 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.26 psia

NOTES

XLO	o-XYLENE

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	56.460	35	.389	35	1.043	15	1.328
20	56.330	40	.391	40	1.035	20	1.263
25	56.190	45	.394	45	1.027	25	1.202
30	56.050	50	.396	50	1.018	30	1.145
35	55.910	55	.398	55	1.010	35	1.092
40	55.770	60	.400	60	1.002	40	1.042
45	55.630	65	.402	65	.993	45	.995
50	55.490	70	.404	70	.985	50	.952
55	55.360	75	.406	75	.977	55	.911
60	55.220	80	.408	80	.969	60	.873
65	55.080	85	.411	85	.960	65	.836
70	54.940	90	.413	90	.952	70	.802
75	54.800	95	.415	95	.944	75	.770
80	54.660	100	.417	100	.935	80	.740
85	54.520					85	.712
90	54.380						
95	54.250						
100	54.110						

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	.071	60	.00135	0	.261
	N	70	.101	70	.00188	25	.274
	S	80	.141	80	.00258	50	.287
	O	90	.194	90	.00349	75	.299
	L	100	.263	100	.00464	100	.311
	U	110	.352	110	.00611	125	.323
	B	120	.465	120	.00794	150	.335
	L	130	.609	130	.01021	175	.347
	E	140	.787	140	.01298	200	.358
		150	1.007	150	.01634	225	.370
		160	1.277	160	.02038	250	.381
		170	1.605	170	.02520	275	.392
		180	1.999	180	.03090	300	.403
		190	2.469	190	.03759	325	.414
		200	3.028	200	.04539	350	.424
		210	3.686	210	.05443	375	.435
		220	4.456	220	.06484	400	.445
		230	5.352	230	.07674	425	.455
		240	6.389	240	.09030	450	.465
		250	7.581	250	.10560	475	.475
		260	8.947	260	.12290	500	.485
						525	.494
						550	.504
						575	.513
						600	.522

m-XYLENE

XLM

Common Synonyms
1, 3-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 materials.
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 shorelines.
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: 867°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.), 5 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: 268.4°F = 131.9°C = 405.1°K
12.4 Freezing Point: −54.2°F = −47.9°C = 225.3°K
12.5 Critical Temperature: 650.6°F = 343.6°C = 617.0°K
12.6 Critical Pressure: 513.8 atm = 34.86 psia = 3.540 MN/m²
12.7 Specific Gravity: 0.864 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.8 dynes/cm = 0.0288 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 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: 147 Btu/lb = 81.9 cal/g = 3.43 X 10⁵ J/kg
12.13 Heat of Combustion: −17,564 Btu/lb = −9762.4 cal/g = −408.31 X 10⁵ 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 Values: Data not available
12.27 Reid Vapor Pressure: 0.34 psia

NOTES

XLM	m-XYLENE

12.17 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
15	55.400
20	55.260
25	55.130
30	54.990
35	54.850
40	54.710
45	54.570
50	54.430
55	54.290
60	54.160
65	54.020
70	53.880
75	53.740
80	53.600
85	53.460
90	53.320
95	53.180
100	53.050

12.18 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
40	.387
50	.393
60	.398
70	.404
80	.410
90	.415
100	.421
110	.426
120	.432
130	.437
140	.443
150	.448
160	.454
170	.460
180	.465
190	.471
200	.476
210	.482

12.19 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
35	.962
40	.953
45	.944
50	.935
55	.926
60	.917
65	.908
70	.899
75	.890
80	.881
85	.873
90	.864
95	.855
100	.846

12.20 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
15	.938
20	.898
25	.862
30	.827
35	.794
40	.764
45	.735
50	.708
55	.682
60	.658
65	.635
70	.613
75	.592
80	.572
85	.554

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
60	.090
70	.127
80	.177
90	.242
100	.326
110	.434
120	.571
130	.743
140	.956
150	1.219
160	1.538
170	1.924
180	2.388
190	2.939
200	3.590
210	4.355
220	5.247
230	6.282
240	7.476
250	8.846
260	10.410

12.23 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
60	.00172
70	.00238
80	.00324
90	.00435
100	.00577
110	.00754
120	.00975
130	.01247
140	.01577
150	.01977
160	.02455
170	.03023
180	.03691
190	.04473
200	.05382
210	.06431
220	.07635
230	.09009
240	.10570
250	.12330
260	.14310

12.24 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	.247
25	.260
50	.273
75	.286
100	.299
125	.311
150	.324
175	.336
200	.348
225	.360
250	.371
275	.383
300	.394
325	.406
350	.417
375	.427
400	.438
425	.449
450	.459
475	.469
500	.479
525	.489
550	.499
575	.508
600	.517

APPENDIX N.2

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) POSTER

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 or 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 the 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 discriminatory action.

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 civil penalties against employers of up to $7,000 for each serious violation and for optional penalties of up to $7,000 for each nonserious violation. Penalties of up to $7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $70,000 for each such violation. A violation of posting requirements can bring a penalty of up to $7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to $250,000 (or $500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of $10,000 or up to six months in jail or both.

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.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. 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 health such as training.

VOLUNTARY ACTIVITY

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State labor or Health department or a State university.

POSTING INSTRUCTIONS

Employees in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

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

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	(404) 347-3573
Boston, Massachusetts	(617) 565-7164
Chicago, Illinois	(312) 353-2220
Dallas, Texas	(214) 767-4731
Denver, Colorado	(303) 844-3061
Kansas City, Missouri	(816) 426-5861
New York, New York	(212) 337-2378
Philadelphia, Pennsylvania	(215) 596-1201
San Francisco, California	(415) 744-6670
Seattle, Washington	(206) 442-5930

Washington, D.C.
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OSHA 2203

Lynn Martin, Secretary of Labor
U.S. Department of Labor
Occupational Safety and Health Administration

To report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

APPENDIX O

BASELINE RISK ASSESSMENT

IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN (CPCs)

After the data have been evaluated, the following steps will be used to identify CPCs in the quantitative risk assessment:

- qualitatively evaluate tentatively identified compounds;
- compare OU 3-related compounds to the most current USEPA Region III risk-based concentration table to screen out compounds;
- consider mobility, persistence, bioaccumulation potential, and potential significant exposure routes of chemicals; and
- perform the statistical analyses (upper 95 percent confidence limit) deemed appropriate for the evaluation.

Usable data for the quantitative risk assessment will be identified and summarized. A cluster analysis of the chemical data will be conducted to aid in evaluating trends or "hot spots." The upper 95 percent confidence limit will be calculated for appropriate data. In calculating the 95 percent UCLs, unless an analyte is not detected in the sample set for a specific medium, non-detections are assigned a value of one-half the associated SQL in the calculation of the arithmetic mean. In cases where there are fewer than four samples or where the UCL is greater than the maximum detected concentration, the maximum detected concentration is identified as the exposure point concentration. Chemicals that will not be carried through to the risk assessment will be identified and justification for the omission will be provided.

EXPOSURE ASSESSMENT

The assumptions used to estimate exposure concentrations are listed below.

- Groundwater:

  Following Region IV guidance for evaluation of Class G 1 groundwater (USEPA, 1991b), monitoring well data from the shallow aquifer will be used in the future use scenarios. The values for concentrations will be assumed equal to the values detected at OU 3.

  Contaminant concentrations from unfiltered water samples will be used to estimate exposure concentrations.

- Soil and Sediment:

  The concentrations detected in soil borings and monitoring well installation borings will be used to calculate exposure concentrations for both current and future land uses.

  Surface soil samples (0 to 12 inches bls) will be considered separately from subsurface samples (from the base of the concrete to the water table) for inhalation and ingestion exposures.

- Air:

  Currently, potential sources of air emissions include volatilization from surface soil and fugitive dust emissions at PSC-15.

  If contaminants are present in the surface soil, models may be selected from the National Technical Guidance Series (USEPA, 1989), the *Superfund Exposure Assessment Manual* (USEPA, 1988), or current literature to estimate fugitive dust emissions.

  Air monitoring data will be used to estimate exposures to volatile emissions if VOCs are found in surface soil.

- Surface Water:

  Surface water exposure concentrations will be estimated using data collected from the St. Johns River.

The equations used to estimate chemical intake are provided in Table O-1. Tables O-2 through O-5 list the default exposure parameters for each exposure scenario.

Human Health Remediation. Sample calculations for developing remedial goal options for carcinogenic and noncarcinogenic contaminants are provided in Table O-6.

Table O-1
Equations Used To Estimate Chemical Intake

RI/FS Workplan, Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

INGESTION OF SOIL OR SEDIMENT:

$$\text{Intake(mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CS = chemical concentration in soil (mg/kg)
IR = ingestion rate (mg soil/day)
CF = conversion factor (10^{-6} kg/mg)
FI = fraction ingested from site
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time–period over which exposure is averaged (days)

DERMAL CONTACT WITH SOIL OR SEDIMENT

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times AF \times SA \times RAF \times CF \times EF \times ED}{BW \times AT}$$

where:

CS = chemical concentration in soil (mg/kg)
AF = soil to skin adherence factor (mg/cm^2)
SA = skin surface area exposed (cm^2/event)
RAF= relative absorption factor (unitless)
CF = conversion factor (10^{-6} kg/mg)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time–period over which exposure is averaged (days)

INHALATION OF SUSPENDED PARTICULATES

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

where:

CA = CS x (1/PEF)
CS = chemical concentration in soil (mg/kg)
IR = inhalation rate (m^3/hour)
ET = exposure time (hours/event)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time–period over which exposure is averaged (days)

Notes: CA = concentration in air (milligrams per cubic meter [mg/m^3]).
PEF = particulate emission factor (cubic meter per kilogram [m^3/kg]).

Table O-1 (Continued)
Equations Used To Estimate Chemical Intake

RI/FS Workplan, Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

INGESTION OF SURFACE WATER

$$\text{Intake (mg/kg-day)} = \frac{CW \times CR \times ET \times EF \times ED}{BW \times AT}$$

where:

CW = chemical concentration in water (mg/ℓ)
CR = contact rate (L/hour)
ET = exposure time (hours/event)
EF = exposure frequency (events/year)
ED = exposure duration (years)
BW = body weight
AT = averaging time--period over which exposure is averaged (days)

DERMAL CONTACT WITH SURFACE OR GROUND WATER

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

CW = chemical concentration in water (mg/ℓ)
SA = skin surface area (cm^2/event)
PC = chemical specific dermal permeability constant $(cm/hr)^3$
ET = exposure time (hours/event)
EF = exposure frequency (events/year)
ED = exposure duration (years)
CF = conversion factor (1 liter/1000 cm^3)
BW = body weight (kg)
AT = averaging time--period over which exposure is averaged (days)

INGESTION OF GROUNDWATER

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

CW = chemical concentration in water (mg/ℓ)
IR = inhalation rate (m^3/day)
EF = exposure frequency
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time--period over which exposure is averaged (days)

INHALATION OF VOLATILES FROM HOUSEHOLD WATER USE

$$\text{Intake (mg/kg-day)} = \frac{CW \times K \times IR \times EF \times ED}{BW \times AT}$$

where:

CW = chemical concentration in water (mg/ℓ)
K = volatilization factor (unitless)
IR = inhalation rate (m^3/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time--period over which exposure is averaged (days)

Reference: U.S. Environmental Protection Agency (USEPA), 1989b.

Table O-2
Exposure Parameters
Occupational Soil Contact
Construction Worker (Adult)

RI/FS Workplan, Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

Parameter	Construction Worker	Units	Source
Soil Ingestion Rate	110	mg/day	[1]
Soil Adherence Factor	1	mg/cm^2	[2]
Surface Area Exposed[3]	3,000	cm^2	[2]
Fraction Ingested From Site	100%		Assumption
Exposure Frequency[4]	130	days/year	Assumption
Exposure Duration	1	years	Assumption
Body Weight	70	kg	[1]
Averaging Time			[1]/Assumption
Cancer	70	years	
Noncancer	1	years	

[1] U.S. Environmental Protection Agency (USEPA), 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors." Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03
[2] USEPA, 1992, Dermal Exposure Assessment: Principles and Applications EPA 600/8-91/011B; January 1992.
[3] 50th percentile; Hands and forearms.
[4] Construction Worker - 5 days/week, 26 weeks/year.

Notes: mg = milligrams.
cm^2 = square centimeters.
kg = kilograms.

Table O-3
Default Exposure Parameters
Occupational Inhalation Exposure
Construction Work (Adult)

RI/FS Workplan, Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

Parameter	Construction Worker	Units	Source
Inhalation Rate	20	m^3/hour	[1]
Exposure Frequency[2]	30	days/year	[1]/Assumption
Exposure Duration	1	years	[1]/Assumption
Body Weight	70	kg	[1]
Averaging Time			
Cancer	70	years	[1]
Noncancer	1	years	[1] Assumption

[1] U.S. Environmental Protection Agency, 1991. Human Health Evaluation Manual.
[2] Construction worker, 5 days per week, 26 weeks per year.

Notes: m^3 = cubic meters.
kg = kilograms.

Table O-4
Exposure Parameters
Residential Use of Potable Water

RI/FS Workplan, Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

Parameter	Adult 7 - 30	Units	Source
Water Ingestion Rate	2	liter/day	[1]
Exposure Time - Showering	12 (0.2)	min/day (hrs/day)	[2]
Exposure Frequency	350	days/years	[1]
Exposure Duration	30	years	[1]
Body Weight	70	kg	USEPA, 1991b
Averaging Time			
Cancer	70	years	[1]
Noncancer	24	years	[1]

[1] U.S. Environmental Protection Agency (USEPA) 1991, Human Health Evaluation Manual: "Standard Default.
[2] USEPA, 1989, Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, (Part A) EPA/540/1-89/002; December 1989.

Notes: m^3 = cubic meters.
cm^2 = square centimeters.
min = minutes.
kg = kilograms.

Table O-5
Default Exposure Parameters
Swimming

RI/FS Workplan. Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

Parameter	Child 6 - 16	Adult 7 - 30	Units	Source
Water Ingestion Rate	50	50	ml/hour	USEPA, 1989b
Surface Area Exposed[1]	7,195	18,150	cm^2	USEPA, 1990c
Exposure Time	2.6	2.6	hours/day	USEPA, 1989b
Exposure Frequency	45	45	days/year	USEPA, 1991b
Exposure Duration	6	24	years	USEPA, 1989b
Body Weight	15	70	kg	USEPA, 1989b, 1991c
Averaging Time				
Cancer	70	70	years	USEPA, 1989b
Noncancer	6	24	years	USEPA, 1989b

[1] 50th percentile; Whole body

Notes: ml = milliliters.
cm^2 = square centimeters.
kg = kilograms.

Table O-6
Equation For Remedial Goals Options

RI/FS Workplan, Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

Residential Water - Carcinogenic Effects

$$C(mg/L;\ risk\text{-}based) = \frac{TR \times BW \times AT \times 365\ days/yr}{EF \times ED \times [(SF_i \times K \times IR_a) + (SF_o \times IR_w)]} + (SF_d \times SA \times PC)]$$

where:

Parameters	Definition
C	chemical concentration in water (mg/ℓ)
TR	target excess individual lifetime cancer risk (unitless)
SF_i	inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$)
SF_o	oral cancer slope factor $(mg/kg\text{-}day)^{-1}$)
BW	adult body weight (kg)
AT	averaging time (yr)
EF	exposure frequency (days/yr)
ED	exposure duration (yr)
IR_a	daily indoor inhalation rate (m^3/day)
IR_w	daily water ingestion rate (L/day)
K	volatilization factor (unitless)
SF_d	dermal cancer slope factor $(mg/kg\text{-}day^{-1})$
SA	skin surface area (cm^2/event)
PC	permeability constant $(cm/hr)^3$

Residential Water - Noncarcinogenic Effects

$$C(mg/L;\ risk\text{-}based) = \frac{THI \times BW \times AT \times 365\ days/yr}{EF \times ED \times [(RfD_i \times K \times IR_a) + (RfD_o \times IR_w)]} + \frac{1}{RfD_d} \times SA \times PC$$

where:

Parameters	Definition
C	chemical concentration in water (mg/ℓ)
THI	target hazard index (unitless)
RfD_o	oral chronic reference dose (mg/kg-day)
RfD_i	inhalation chronic reference dose (mg/kg-day)
BW	adult body weight (kg)
AT	averaging time (yr)
EF	exposure frequency (days/yr)
ED	exposure duration (yr)
IR_a	daily indoor inhalation rate (m^3/day)
IR_w	daily water ingestion rate (L/day)
%	volatilization factor (unitless)
RfD_d	dermal chronic reference dose
SA	skin reference area (cm^3/event)
PC	permeability constant $(cm/hr)^3$

Table O-6 (Continued)
Equation For Remedial Goals Options

RI/FS Workplan. Operable Unit 3
NAS Jacksonville
Jacksonville, Florida

Soil - Carcinogenic Effects

$$C = \frac{TR \times BW \times AT \times 365\ days/year}{EF \times ED \times [(SF_o \times IR \times FI) + (SF_d \times AF \times SA \times RAF) + (SF_i \times IhR \times ET)]}$$

where:

Parameters	Definition
C	chemical concentration in soil (mg/ℓ)
TR	target excess individual lifetime cancer risk (unitless)
SF_o	oral cancer slope factor $(mg/kg\text{-}day)^{-1}$)
SF_d	dermal cancer slope factor $(mg/kg\text{-}day)^{-1}$)
SF_i	inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$)
BW	adult body weight (kg)
AT	averaging time (yr)
EF	exposure frequency (days/yr)
ED	exposure duration (yr)
IR	ingestion rate (mg/day)
FI	fraction ingested (mg/day)
AF	soil to skin adherence factor (mg/cm^2)
SA	skin surface area exposed (cm^2/event)
RAF	relative absorption factor
IhR	inhalation rate (m^3/hr)
ET	exposure time (hours/event)

Soil Non-carcinogenic Effects

$$C = \frac{THI \times BW \times AT 365\ days/yr}{EF \times ED \times [(1/RfD_o \times IR \times FI) + (1/RfD_d \times AF \times SA \times RAF) + (1/RFD_i \times IhR \times ET)]}$$

where:

Parameters	Definition
C	chemical concentration in soil (mg/ℓ)
THI	target hazard index (unitless)
RfD_o	oral chronic reference dose (mg/kg-day)
RfD_d	dermal reference dose
RfD_i	inhalation chronic reference dose (mg/kg-day)
BW	adult body weight (kg)
AT	averaging time (yr)
EF	exposure frequency (days/yr)
ED	exposure duration (yr)
IR_a	daily indoor inhalation rate (m^3/day)
IR_w	daily water ingestion rate (L/day)
%	volatilization factor (unitless)
SA	skin reference area (cm^3/event)
PC	permeability constant $(cm/hr)^3$ chemical specific

TABLE O-6 Equation For Remediation Goals
NAS OU 3
JACKSONVILLE, FLORIDA

RESIDENTIAL WATER - NONCARCINOGENIC EFFECTS

$$THI = \frac{C \times IR_w \times EF \times ED}{R\int D_o \times BW \times AT \times 365 days/yr} + \frac{C \times K \times IR_a \times EF \times ED}{R\int D_i \times BW \times AT \times 365 days/yr}$$

$$= \frac{EF \times ED \times C \times \left[\left(1/R\int D_o \times IR_w\right) + \left(1/R\int D_i \times K \times IR_a\right)\right]}{BW \times AT \times 365 days/yr}$$

$$C(mg/L;\ risk\text{-}based) = \frac{THI \times BW \times AT \times 365 days/yr}{EF \times ED \times \left[\left(1/R\int D_i \times K \times IR_a\right) + \left(1/R\int D_o \times IR_w\right)\right]}$$

where:

Parameters	Definition	Default Value
C	chemical concentration in water (mg/L)	—
THI	target hazard index (unitless)	1
RfD_o	oral chronic reference dose (mg/kg-day)	chemical-specific
RfD_i	inhalation chronic reference dose (mg/kg-day)	chemcial-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yr)	30 yr (for carcinogens, equal to ED)
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yr)	30 yr
IR_a	daily indoor inhalation rate (m^3/day)	15 m^3/day
IR_w	daily water ingestion rate (L/day)	2 L/day

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