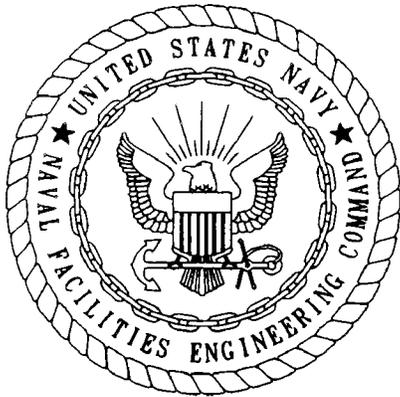


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REMEDIAL INVESTIGATION FEASIBILITY STUDY HEALTH AND SAFETY PLAN FOR
OPERABLE UNIT 2 (OU 2) NAS JACKSONVILLE FL
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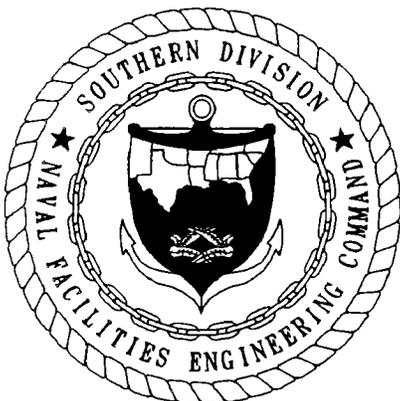


**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
HEALTH AND SAFETY PLAN
OPERABLE UNIT 2**

**NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA**

**UNIT IDENTIFICATION CODE: N00207
CONTRACT NO. N62467-89-D-0317/076**

AUGUST 1995



**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
HEALTH AND SAFETY PLAN (HASP)**

OPERABLE UNIT 2

**NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA**

Unit Identification Code (UIC): N00207

Contract No. N62467-89-D-0317/076

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August 1995



CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/076 are complete and accurate and comply with all requirements of this contract.

DATE: August 9, 1995

NAME AND TITLE OF CERTIFYING OFFICIAL: Peter Redfern
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Fredrick Bragdon
Project Technical Lead

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Jacksonville, Florida

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REFERENCES

The following chapters of the Comprehensive Long-term Environmental Action Navy (CLEAN) Program District I Generic HASP, dated March 1993, are applicable for the work anticipated at the Site.

- 2.0 AUTHORITY AND RESPONSIBILITY OF HEALTH AND SAFETY PERSONNEL
- 3.0 TRAINING PROGRAM
- 4.0 MEDICAL SURVEILLANCE PROGRAM
- 5.0 ENGINEERING CONTROLS
- 6.0 PERSONAL PROTECTIVE LEVEL DETERMINATION
- 7.0 MONITORING EQUIPMENT
- 8.0 ZONATION
- 9.0 WORK PRACTICES
- 10.0 CONFINED SPACE ENTRY PROCEDURES
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- 15.0 HEALTH AND SAFETY FORMS AND DATA SHEETS
 - HEALTH AND SAFETY AUDIT FORM
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 - HEALTH AND SAFETY OFFICER (HSO) CHECKLIST FOR FIELD OPERATIONS
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- 16.0 RESPIRATORY PROTECTION PROGRAM
- 17.0 OTHER
 - ILLUMINATION
 - SANITATION
 - HEALTH AND SAFETY AUDIT PROCEDURES

GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
ACGIH	American Conference of Governmental Industrial Hygienists
CFR	Code of Federal Regulations
CHRIS	Chemical Hazards Response Information System
CLEAN	Comprehensive Long-Term Environmental Action, Navy
COC	contaminant of concern
DDE	dichlorodiphenyldichloroethene
DPT	direct push technology
FID	flame ionization detector
FOL	Field Operations Leader
GW	groundwater
HASP	Health and Safety Plan
HEPA	high-efficiency particulate air
HSM	Health and Safety Manager
HSO	Health and Safety Officer
HSS	Health and Safety Supervisor
LEL	lower explosive limit
MCE	mixed cellulose-ester acetate
mg/kg	milligrams per kilogram
mg/m ³	milligrams per cubic meter
mm	millimeters
MSA	mine safety appliances
MSDS	Material Safety Data Sheets
NADEP	Naval Aviation Depot
NAS	Naval Air Station
NIOSH	National Institute of Occupational Safety and Health
O ₂	oxygen
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OVA	organic vapor analyzer
PEL	permissible exposure limit
PPE	personal protective equipment
ppm	parts per million
PSC	potential source of contamination
RCRA	Resource Conservation and Recovery Act
RDM	respirable dust meter
RI	Remedial Investigation
SOPs	Standard Operating Procedures
TOM	Task Order Manager
TRPH	total recoverable petroleum hydrocarbon
TWA	time weighted average

GLOSSARY (Continued)

USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds
WWTP	Wastewater Treatment Plant

1.0 GENERAL

1.1 SCOPE AND PURPOSE. This site-specific 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) Part 1910.120. As such, the site-specific HASP addresses those activities associated with field operations for this project. Compliance with this HASP is required for all ABB-ES personnel, contractor personnel, or third parties entering the site.

1.2 PROJECT PERSONNEL. This section describes the project personnel and their general responsibilities for the project.

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 Manager The Health and Safety Manager (HSM) has final authority over health and safety issues that are not resolved at the site or through the Health and Safety Supervisor (HSS) and has overall responsibility for ensuring that the policies and procedures of this HASP are implemented by the Health and Safety Officer (HSO). The HSM may delegate additional functions to the regional HSS.

1.2.4 Health and Safety Supervisor The HSS is the health and safety professional serving as the ABB-ES HSM's designee for this project. As such, the HSS will be responsible for (1) approval of the individual chosen to serve as the site HSO for this field operation, (2) review and approval of site-specific HASPs developed by the HSO as well as any significant changes made over time to the site HASP, (3) oversight of the daily efforts of the HSO, (4) resolution of site disputes involving health and safety issues, and (5) implementation of the HASP by the HSO. The HSS will notify the HSM of any stop-work orders issued by an HSO.

1.2.5 Health and Safety Officer The HSO will have at least an indirect line of reporting to the HSM through the HSS for the duration of his or her 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 descriptions of the duties of the HSM, HSS, and HSO are provided in Part II, Appendix A, of the ABB-ES generic HASP dated June 1990.

1.2.6 Field Engineers and Scientists This category includes engineers, scientists, and technicians who perform site reconnaissance, geophysical surveys, surface water and sediment sampling, soil sampling, groundwater sampling, and oversight for onsite subcontractors.

1.3 TRAINING. Training is defined in Chapter 3.0 of the CLEAN program HASP dated March 1991. 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., in the exclusion zone).

As indicated in Chapter 3.0 of this HASP, the contaminants of concern (COCs) known or suspected to be present onsite may include cadmium. OSHA requires additional training for workers who may come in contact with this contaminant. All workers with a potential for exposure to airborne cadmium must receive training in the cadmium standard (29 CFR 1910.1027). A record must be maintained of the contents of the training program. The training shall be provided prior to the start of the job and annually thereafter. The required topics associated with the cadmium standard training program can be found in Appendix A of this 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 Part II, Appendix C, of the ABB-ES generic HASP dated June 1990. Personnel who have not received medical clearance will not be permitted in any area with a potential for exposure to toxic substances or harmful physical agents (i.e., in the exclusion zone). Chapter 4.0 of the Navy CLEAN HASP dated March 1991 contains further information on medical surveillance programs.

As indicated in Chapter 3.0 of this HASP, the COCs known or suspected to be present onsite may include cadmium and chromium. Medical surveillance in addition to that mentioned above is required for workers who may come in contact with these contaminants. Blood cadmium analyses (cadmium and zinc protoporphyrin levels) will be conducted before working in areas with high cadmium contaminant levels (potential sources of contamination [PSCs] 41, 43, and 3) or in areas with a potential for high cadmium levels where the work conducted could result in levels above the permissible exposure limit (PEL). The same analyses will be conducted after work at the site has been completed. Biological monitoring for chromium will be conducted on all personnel who have a potential to be exposed to chromium at levels above the action limits. This monitoring will be conducted before working in areas with actual or potentially high concentrations of these contaminants as well as after work at the site has been completed. More information on this medical surveillance can be found in Appendix B of this HASP.

2.0 SITE CHARACTERIZATION AND TASK ANALYSIS

2.1 SITE HISTORY AND LAYOUT. Naval Air Station (NAS) Jacksonville is located in southern Duval County approximately 9 miles south of downtown Jacksonville. NAS Jacksonville occupies approximately 3,800 acres on the west bank of the St. Johns River, which flows to the north toward downtown Jacksonville.

Operable Unit (OU) 2 has been primarily used for NAS wastewater treatment. A secondary use has been for firefighting training. OU 2 soil and groundwater may have been impacted by operations of the wastewater treatment plant (WWTP) and fire-fighting exercises. Six PSCs have been identified at OU 2 and are described below.

2.1.1 Former Fire-Fighting Training Area (PSC 2) This area consists of an approximately 120-foot-diameter unlined circular pit. An estimated 6,000 gallons of fuel were burned annually. This area is currently scheduled for remediation and source removal.

2.1.2 Wastewater Treatment Plant (WWTP) Sludge Disposal Area (PSC 3) Approximately 20,000 tons of domestic and industrial sewage sludge, reportedly containing metals and organic compounds, were disposed of at PSC 3 from 1962 to 1980. The 15-acre area consists of two approximately equal parcels divided by an access road. No written records exist regarding quantities, locations, and the timing of sludge disposal in the two parcels. Some sampling has occurred in this area as a result of a focused remedial investigation.

2.1.3 Pine Tree Planting Area (PSC 4) This area originally consisted of an area south of the WWTP. From 1968 to 1975, this area reportedly was used for disposal of wastewater treatment plant sludge, asbestos, and petroleum products. Sometime after 1975 this area was planted with pine trees. The east to west area parallel to the taxiway was added to this PSC.

2.1.4 Domestic Waste Sludge Drying Beds (PSC 41) The domestic waste sludge drying beds, constructed in 1970 to receive sludge from the anaerobic digester, operated until 1987. The system consists of five unlined beds, each measuring 50 by 50 feet, and received both domestic and industrial sludge. In 1987, USEPA classified the domestic waste sludge drying beds as a surface impoundment operated to treat Resource and Recovery Act (RCRA)-listed hazardous waste F006, which is wastewater treatment sludge from electroplating operations, and F019, which is wastewater treatment sludge from the chemical conversion coating of aluminum (40 CFR 261). The domestic waste sludge drying beds were permanently removed from service on June 10, 1987, with the remaining sludge removed and taken to an authorized landfill in 1991. This area is currently scheduled for remediation and source removal.

2.1.5 Industrial Waste Sludge Drying Beds (PSC 43) The industrial waste sludge drying beds (PSC 43) were constructed in 1980 to dewater industrial wastewater treatment sludge from electroplating operations. Approximately 8,250 gallons of dried sludge were excavated annually from the drying beds. The USEPA classified the industrial waste sludge drying beds as a surface impoundment operated to treat RCRA-listed hazardous waste F006, which is wastewater treatment sludge from electroplating operations, and F019, which is wastewater treatment sludge from the chemical conversion coating of aluminum (40 CFR 261). The industrial waste

sludge drying beds were permanently removed from service in November 1988, with the remaining sludge removed and taken to an RCRA-authorized landfill in 1991. This area is currently scheduled for remediation and source removal.

2.1.6 WWTP Effluent Polishing Pond (PSC 42) The polishing pond was built in 1970 to provide final clarification for approximately 2.3 million gallons per day of combined domestic and industrial wastewater-treated effluent, prior to chlorination and discharge to the St. Johns River. USEPA classified the polishing pond as a surface impoundment operated to treat RCRA-listed hazardous waste F006, which is wastewater treatment sludge from electroplating operations, and F019, which is wastewater treatment sludge from the chemical conversion coating of aluminum (40 CFR 261). The pond was permanently removed from service on May 23, 1987, and is currently filled with water. This area is currently scheduled for remediation and source removal.

2.2 TASK AND ACTIVITY DESCRIPTIONS. The RI field sampling event will include the following tasks:

- site walkovers,
- topographic surveys,
- ecological inventories,
- surface soil sampling,
- subsurface soil sampling,
- sediment and surface water sampling,
- collection of geotechnical information with cone penetrometer testing equipment using direct push technology (DPT),
- groundwater sampling using a hydrocone,
- monitoring well installation,
- collection of groundwater samples from monitoring wells, and
- groundwater pumping test.

The hazardous substances, risks, and protective measures identified and described in Chapter 3.0 apply to all these tasks.

3.0 HAZARD AND LEVEL OF PROTECTION EVALUATION

3.1 HAZARDOUS SUBSTANCES. Based on the available data, the COCs known or suspected to be present onsite, along with any established exposure limits for those substances, are listed in Tables 3-1 and 3-2. These tables contain the COCs common to all locations within the OU as well as a breakdown of COCs by PSC.

3.2 SITE RISKS. Site risks are chemical or physical hazards that may be encountered when performing the tasks identified in Chapter 2.0 of this HASP. These potential hazards may be directly associated with the health and/or safety of personnel working at OU 2. A brief description of each is given below. It should be noted that this list may change as more information about the site is available.

3.2.1 Health Hazards Personnel may be exposed to volatile, semivolatile, and/or inorganic contaminants, including cadmium and chromium. Available hazardous substance information forms (Chemical Hazards Response Information System [CHRIS] data sheets) for most COCs are contained in Appendix C of this HASP. All anticipated 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.

3.2.2 Safety Hazards Safety hazards include those hazards that personnel may be exposed to that are unrelated to hazardous waste. These include hazards such as heat stress, operation of and presence around heavy equipment, lifting of objects, vehicle traffic, and snake bites. Extreme caution should be exhibited by all personnel while conducting work around drill rigs, backhoes, 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. Heavy objects should be lifted with caution. Personnel should assist one another when moving heavy objects or use the appropriate equipment to accomplish these tasks. During all site activities, personnel should be aware of the possibility of encounters with poisonous snakes.

Power substations, powerlines, 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). Safety hazards and methods to reduce employee exposure to hazardous substances is addressed in the following chapters of the CLEAN program HASP dated March 1991: Chapter 6.0, Personal Protective Equipment; Chapter 7.0, Monitoring Equipment; Chapter 9.0, Work Practices; Chapter 12.0, Temperature Extremes; Chapter 13.0, Decontamination; and Chapter 14.0, Emergency Planning.

3.2.3 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 moderate to low, assuming appropriate health and safety practices are maintained.

**Table 3-1
Contaminants of Concern for Operable Unit (OU) 2**

Health and Safety Plan
Naval Air Station Jacksonville
Jacksonville, Florida

Constituent	Maximum ¹ Reported Concentrations	PEL/TLV	Media ¹
Volatile Organic Compounds (VOCs)			
Benzene	NA	1	Groundwater
1,1-Dichloroethane	0.187	100	Groundwater
1,1,1-Trichloroethane	0.014	350	Groundwater
Tetrachloroethane	0.001	1	Groundwater
Trichloroethene	0.045	50	Groundwater
Tetrachloroethene	0.015	25	Groundwater
Toluene	0.054	100	Groundwater
Methylene chloride	1.3	50	Groundwater
Methyl ethyl ketone	0.016	200	Groundwater
Vinyl chloride	NA	1	Groundwater
Xylene	NA	100	Groundwater
Semivolatile Organic Compounds (SVOCs)			
Phenol	1.5	5	Groundwater
Cresol	0.4	5	Groundwater
¹ Groundwater, surface, water, soil, or air.			
Notes: Concentrations are reported in milligrams per liter. PEL = permissible exposure limit. TLV = threshold limit value. NA = not applicable.			

**Table 3-2
Contaminants of Concern for Potential Sources of Contamination (PSCs)
2, 3, 41, 42, and 43**

Health and Safety Plan
Naval Air Station Jacksonville
Jacksonville, Florida

Constituent	Maximum ¹ Reported Concentrations	TWA ² mg/m ³ (ppm)	Media ³
PSC 2 Volatile Organic Compounds			
Ethylbenzene	7	435 (100)	Soil
2-Butanone	24	590 (200)	Soil
4-Methyl-2-pentanone	550	Not available	Soil
Xylene	35	435 (100)	Soil
PSC 2 Semivolatile Organic Compounds			
Dibenz(a,h)-anthracene	73	NA	Soil
Chrysene	81	NA	Soil
Pyrene	140	NA	Soil
Benzo(g,h,i)-perylene	150	NA	Soil
Benzo(k)fluoranthene	170	NA	Soil
Indeno-(1,2,3cd)pyrene	170	NA	Soil
Benzo(a)-pyrene	210	NA	Soil
Benzo(b)fluoranthene	260	NA	Soil
2-Methyl-naphthalene	11,000	NA	Soil
Naphthalene	4,100	50 (10)	Soil
PSC 2 Pesticides and Polychlorinated Biphenyls (PCBs)			
alpha-Chlordane	2.9	⁴ 0.5 [skin]	Soil
gamma-Chlordane	3.6	⁴ 0.5 [skin]	Soil
Dieldrin	13	⁴ 0.25 [skin]	Soil
4,4'-DDE	1	NA	Soil
PSC 2 Inorganics			
Aluminum	3,090	NA	Soil
Arsenic	0.93	⁴ 0.010	Soil
Barium	121	0.5	Soil
Cadmium	7.2	⁴ 0.2	Soil
Chromium	17.6	0.5	Soil
Copper	90.9	1.0	Soil
Lead	133	0.05	Soil
Manganese	24.3	1.0	Soil
Mercury	0.1	0.01	Soil
Zinc	260	NA	Soil
PSC 2 Total Petroleum Hydrocarbons			
TRPH	642	NA	Soil
PSC 3 Semivolatile Organic Compounds			
Phenol	230	19 (5) [skin]	Soil
bis(2-Ethylhexyl)phthalate	390	NA	Soil
Butylbenzylphthalate	390	NA	Soil
Di-n-Octyl-phthalate	200	NA	Soil
See notes at end of table.			

Table 3-2 (Continued)
Contaminants of Concern for Operable Unit (OU) 2

Health and Safety Plan
 Naval Air Station
 Jacksonville, Florida

Constituent	Maximum ¹ Reported Concentration	TWA ² mg/m ³ (ppm)	Media ³
PSC 2 Volatile Organic Compounds			
Ethylbenzene	7	435 (100)	Soil
2-Butanone	24	590 (200)	Soil
4-Methyl-2-pentanone	550	Not Available	Soil
Xylene	35	435 (100)	Soil
PSC 2 Semivolatile Organic Compounds			
Dibenz(a,h)anthracene	73	NA	Soil
Chrysene	81	NA	Soil
Pyrene	140	NA	Soil
Benzo(g,h,i)perylene	150	NA	Soil
Benzo(k)fluoranthene	170	NA	Soil
Indeno(1,2,3cd)pyrene	170	NA	Soil
Benzo(a)pyrene	210	NA	Soil
Benzo(b)fluoranthene	260	NA	Soil
2-Methyl-naphthalene	11,000	NA	Soil
Naphthalene	4,100	50 (10)	Soil
PSC 2 Pesticides and Polychlorinated Biphenyls (PCBs)			
alpha-Chlordane	2.9	⁴ 0.5 [skin]	Soil
gamma-Chlordane	3.6	⁴ 0.5 [skin]	Soil
Dieldrin	13	⁴ 0.25 [skin]	Soil
4,4'-DDE	1	NA	Soil
PSC 2 Inorganics			
Aluminum	3,090	NA	Soil
Arsenic	0.93	⁴ 0.010	Soil
Barium	121	0.5	Soil
Cadmium	7.2	⁴ 0.2	Soil
Chromium	17.6	0.5	Soil
Copper	90.9	1.0	Soil
Lead	133	0.05	Soil
Manganese	24.3	1.0	Soil
Mercury	0.1	0.01	Soil
Zinc	260	NA	Soil
PSC 2 Total Petroleum Hydrocarbons			
TRPH	642	NA	Soil
See notes at end of table.			

Table 3-2 (Continued)
Contaminants of Concern for Operable Unit (OU) 2

Health and Safety Plan
 Naval Air Station
 Jacksonville, Florida

Constituent	Maximum ¹ Reported Concentration	TWA ² mg/m ³ (ppm)	Media ³
PSC 3 Semivolatile Organic Compounds			
Phenol	230	19 (5) [skin]	Soil
bis(2-Ethylhexyl)phthalate	390	NA	Soil
Butylbenzylphthalate	390	NA	Soil
Di-n-Octylphthalate	200	NA	Soil
PSC 3 Pesticides and Polychlorinated Biphenyls (PCBs)			
alpha-Chlordane	5.2	⁴ 0.5 [skin]	Soil
gamma-Chlordane	4.9	⁴ 0.5 [skin]	Soil
Dieldrin	140	⁴ 0.25 [skin]	Soil
PSC 3 Inorganics			
Aluminum	3,230	NA	Soil
Arsenic	0.91	⁴ 0.010	Soil
Barium	33.1	0.5	Soil
Cadmium	5,540	⁴ 0.2	Soil
Chromium	12,200	0.5	Soil
Lead	1,060	0.05	Soil
Mercury	0.25	0.01	Soil
PSC 41 Inorganics			
Aluminum	2,560	NA	Soil
Arsenic	61.1	⁴ 0.01	Soil
Barium	451	0.5	Soil
Cadmium	134	⁴ 0.2	Soil
Chromium	5,310	⁴ 0.5	Soil
Cobalt	20.7	0.05	Soil
Lead	252	0.050	Soil
Manganese	524	5	Soil
Mercury	12.2	0.01	Soil
Nickel	110	⁴ 1	Soil
Silver	110	0.01	Soil
Zinc	454	NA	Soil
PSC 42 Semivolatile Organics			
Phenol	52	19 (5) [skin]	Soil
bis(2-Ethylhexyl)phthalate	1,800	NA	Soil
Butylbenzylphthalate	200	NA	Soil
Di-n-Octylphthalate	270	NA	Soil
PSC 42 Pesticides and Polychlorinated Biphenyls (PCBs)			
alpha-Chlordane	1.9	⁴ 0.5 [skin]	Soil
gamma-Chlordane	1.5	⁴ 0.5 [skin]	Soil
See notes at end of table.			

Table 3-2 (Continued)
Contaminants of Concern for Operable Unit (OU) 2

Health and Safety Plan
 Naval Air Station
 Jacksonville, Florida

Constituent	Maximum ¹ Reported Concentration	TWA ² mg/m ³ (ppm)	Media ³
Dieldrin	5.8	0.25 [skin]	Soil
PSC 42 Inorganics			
Aluminum	7,260 449,000	NA	Soil GW
Antimony	30.7	0.5	GW
Arsenic	28	^0.01	GW
Barium	2,180	0.5	GW
Beryllium	18.9	^0.0005	GW
Cadmium	4,000 14.6	^0.2	Soil GW
Chromium	3,040 445	0.5	Soil GW
Lead	284 65	0.05	Soil GW
Manganese	460	1	GW
Mercury	1.9	0.01	GW
Nickel	147	^1	GW
Selenium	0.65 4.7	0.2	Soil GW
Vanadium	580	NA	GW
Zinc	23.7 426	NA	Soil GW
Cyanide	0.58	5	Soil
PSC 43 Inorganics			
Aluminum	7,950	NA	Soil
Barium	604	0.5	Soil
Cadmium	223	^0.2	Soil
Chromium	47,700	0.5	Soil
Lead	1,220	0.05	Soil
Manganese	4,650	^1	Soil
Nickel	1,540	1	Soil
Silver	256	0.01	Soil
Zinc	1,130	NA	Soil
See notes at end of table.			

**Table 3-2 (Continued)
Contaminants of Concern for Operable Unit (OU) 2**

Health and Safety Plan
Naval Air Station
Jacksonville, Florida

Constituent	Maximum ¹ Reported Concentration	TWA ² mg/m ³ (ppm)	Media ³
<p>¹Maximum reported concentration expressed in milligrams per liter (mg/l) for water and milligrams per kilogram (mg/kg) for soil.</p> <p>²The most conservative of National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), or American Conference of Governmental Industrial Hygienists (ACGIH) permissible exposure limit/threshold limit value (taken from the NIOSH Pocket Guide to Chemical Hazards, June 1990).</p> <p>³Groundwater, surface, water, soil, or air.</p> <p>⁴Considered to be an occupational carcinogen by NIOSH.</p> <p>Notes: mg/m³ = milligrams per cubic meter. ppm = parts per million. PSC = potential source of contamination. NA = not available. GW = groundwater. DDE = dichlorodiphenyldichloroethene. TRPH = total recoverable petroleum hydrocarbons.</p>			

3.3 PROTECTIVE MEASURES. The following are the protective measures that will be used at the site when feasible. These include engineering controls and appropriate levels of personal protection.

3.3.1 Engineering Controls Engineering controls will be used whenever feasible and will include methods to minimize dust exposure whenever appropriate. Engineering controls are described in more detail in Chapter 5.0 of the CLEAN program HASP dated March 1991.

3.3.2 Levels of Protection Because OU 2 is a conglomeration of several PSCs, the levels of protection may vary depending on the location and type of work. At PSCs 41, 42, 43, and 3 the initial level of protection is level D protection and modified level D protection for nonintrusive and intrusive activities, respectively. Modified level D protection is level D protection with the addition of a Tyvek™ suit. Modified level D does not include respiratory protection. Paper Tyveks™ may be used to fulfill this requirement. At PSCs 2 and 4, the initial level of protection is level D protection for all activities.

These levels of protection will only be used when the following is true: (1) the atmosphere contains no unknown hazard, i.e., all atmospheric contaminants have been positively identified, (2) all potential airborne contaminants can be monitored, and (3) work functions preclude splash, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemical. 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 Paragraph 3.4.1.2 of this HASP and in Chapter 6.0 of the CLEAN program HASP dated March 1991.

3.4 MONITORING. It is intended that real-time monitoring instrumentation will be used to monitor the work environment to determine the appropriate level of protection for the site team. (Real-time monitoring instrumentation refers to instruments that allow for instantaneous readings.) Additionally, both historical and current maximum soil concentrations will be used as a criterion for determining the appropriate level of protection as information is available. Monitoring will include, but is not limited to, air sampling and personal monitoring.

3.4.1 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 evaluate 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.

3.4.1.1 Air Sampling Equipment The following air sampling equipment will be used, as required, at all PSCs associated with OU 2 during the Remedial Investigation (RI). All calibration and maintenance will occur in accordance with the manufacturers' specifications or Chapter 7.0 of the CLEAN HASP dated March 1991.

1. flame ionization detector (FID)
2. Draeger pump with benzene tubes
3. respirable dust meter (RDM)

4. lower explosive limit (LEL/O₂) meter

A HeathTech™ total organic vapor analyzer (OVA) equipped with an FID will be used to detect volatile organic compounds (VOCs) present in the atmosphere. This instrument is commonly used onsite to estimate the presence of VOCs for purposes of personnel protection, well screen placement, and selection of samples for further analyses.

A Draeger pump is a bellows-type pump used to draw a known volume of air through a colorimetric detector tube. The contaminant in the air reacts with the indicator chemical, producing a stain the length of which is proportional to the contaminants concentration. Based on the known and suspected COCs, at a minimum, benzene colorimetric tubes will be available for use during the RI.

An RDM will be used at the site in areas where semivolatile contamination and dry dusty conditions exist. This instrument will be used to help determine the presence of airborne particulates that may contain harmful concentrations of COCs.

An LEL/O₂ meter monitors for combustible gases and oxygen. It can be used to determine if an area contains concentrations of combustible gases or a depletion of oxygen. The instrument readings are the percentage of the lower explosive limit (LEL) and the percentage of oxygen.

3.4.1.2 Guidance for Selecting Level of Protection During the RI, work will be performed at all six PSCs. As a result, the levels of protection may vary depending on the location and type of work. Below is a guide for determining the level of protection necessary for the tasks anticipated at OU 2. The equipment mentioned above will be used to monitor the work areas, particularly the breathing zones, of all personnel. Additionally, some special precautions and action levels are provided, based on the location of the work. These guides may be used as the basis for upgrading from the protection levels specified in Subsection 3.3.2. and may also be used as the basis for downgrading from an elevated level of protection. Any changes in level of protection should be done in accordance with this guide and under the direction of the HSO.

Protection from VOCs: At any location within OU 2, if the OVA detects a steady measurable quantity of organic vapors above background at the source, upgrade to modified Level D. If the OVA detects a steady measurable quantity of organic vapors above background in the breathing zone, begin monitoring with a benzene 0.5/c draeger tube. If the benzene tubes indicate benzene concentrations are ≥ 0.5 part per million (ppm), an upgrade to level C protection is required. If the benzene tube indicates benzene concentrations are < 0.5 ppm, continue work at modified level D protection. If the benzene concentrations are < 0.5 ppm, but the OVA reads between 25 and 170 ppm, upgrade to Level C. If benzene concentrations exceed 10 ppm in the breathing zone, Level B is required.

Protection from Semivolatiles: The RDM will be at the site in areas where semivolatile contamination and/or dry dust conditions exist. In areas where there are no elevated levels of cadmium or chromium, upgrade to level C will occur if the RDM reads ≥ 2.5 milligrams per cubic meter (mg/m³).

Protection from Cadmium: In areas (PSC 42, 43, and 3) where elevated levels of cadmium, above the PEL, are known or are suspected to be present, an upgrade to level B protection is required when the RDM readings reach or exceed 45 mg/m³,

specifically at PSCs 3 and 42. This PPE upgrade to level B is required because at this dust level there is a potential for cadmium levels to exceed the OSHA maximum use concentration of 0.25 mg/m³ for cadmium when using a full face cartridge respirator (i.e., there would be a potential for cadmium breakthrough if level C protection were used at this dust level). This is based on maximum cadmium levels found of 5,540 milligrams per kilogram (mg/kg) at PSC 3. The formula to calculate the action limit from Level C protection to Level B protection is as follows:

$$0.25 \text{ mg/m}^3 \times 1,000,000 \text{ parts} \div (\text{maximum concentration in soil}) = \text{action limit (mg/m}^3)$$

The action levels calculated above include all contaminants at the site. If the dust monitor indicates dust is present at greater than or equal to 5 mg/m³, the field team will withdraw from the site.

If cadmium concentrations are above 250 ppm in the soil, there is a potential for breathing zone levels to exceed the OSHA action limit of 0.0025 mg/m³ based on the planned activities and conditions at the site. If historical analytical data indicate specific sampling locations have a potential to exceed this value or if these conditions are encountered during the sampling event, the HSO should contact the HSS and upgrade from level D protection to level C protection. Level C protection may be required as the initial level when working in an area with high cadmium levels or a potential for high cadmium contamination.

Protection from chromium: In areas (PSCs 42, 43, and 3) where elevated concentrations of chromium are known or are suspected to be present, an upgrade to level B protection is required when dust readings reach or exceed 524 mg/m³, specifically at PSC 43. This upgrade from level C protection to level B protection is required because at this dust level there is a potential for chromium levels to exceed the OSHA maximum use concentration when using a full face cartridge respirator (i.e., there would be a potential for chromium breakthrough if level C protection were used at these dust levels). This is based on the maximum chromium levels found at PSC 43 of 47,700 mg/kg. This action level is calculated using the following formula:

$$25 \text{ mg/m}^3 \times 1,000,000 \div (\text{maximum concentration in soil}) = \text{action limit (mg/m}^3)$$

If chromium levels in the soil are above 25,000 ppm, there is a potential for breathing zone levels to exceed the OSHA action limit of 0.25 mg/m³ based on the planned activities and conditions at the site. If historical analytical data indicate specific sampling locations have a potential to exceed this value or if these conditions are encountered during the sampling event, the HSO should contact the HSS of the action limit and upgrade from level D protection to level C protection. Level C protection may be required as the initial level when working in an area with high chromium levels or a potential for high chromium contamination.

Protection from combustible gases and oxygen depletion: The LEL/O₂ meter will be used at the site in areas where there is a potential for combustible gases to be present. If the LEL/O₂ meter indicates combustible gases are at ≥ 10 percent of the LEL, only nonsparking tools should be used. If the meter indicates combustible gases are at ≥ 20 percent of the LEL, all work should stop and all

personnel should evacuate the site. Additionally, if oxygen levels are < 19.5 percent, an upgrade to level B protection is required.

3.4.1.3 Guidance for Selecting Levels of Protection at the Specific PSCs
Following is a breakdown of the levels of protection based on the specific location of the activities. This breakdown should be used in conjunction with the above information. At no time should any change in the level of protection occur without notifying the HSO.

Levels of protection for work at PSC 43

Level D is acceptable if:

- the work is nonintrusive,
- the FID reads less than or equal to background at the source and < 25 ppm in the breathing zone, and
- the benzene 0.5/c Draeger tube reads < 0.5 ppm, or
- the RDM reads < 1.23 mg/m³, or
- the LEL/O₂ meter reads > 19.5 percent.

Modified Level D is required if:

- the work is intrusive (level D is acceptable if the work is nonintrusive),
- the FID reads < or = 25 ppm, and
- the benzene 0.5/c Draeger tube reads < or equal to 0.5 ppm, or
- the RDM reads < 1.23 mg/m³, or
- the LEL/O₂ meter reads > 19.5 percent.

Level C is required if:

- the FID reads between 25 and 170 ppm, and/or
- the benzene 0.5/c Draeger tube reads between 0.5 and 10 ppm,
- the RDM reads ≥ 1.23, or
- the LEL/O₂ meter reads > 19.5 percent.

Level B is required if:

- the FID reads ≥ 170 ppm, or
- the benzene Draeger tube reads 0.5/c ≥ 10 ppm, or
- the RDM reads ≥ 532 mg/m³, or
- the LEL/O₂ meter reads < 19.5 percent.

In addition, stop work and evacuate the site if:

- the RDM reads > 5 mg/m³,
- the LEL/O₂ meter reads ≥ 20 percent.

Levels of protection for work at PSCs 2, 4, and 41

Level D is acceptable if:

- the FID reads less than or equal to background at the source, and
- the benzene 0.5/c Draeger tube reads < 0.5 ppm, or
- the RDM reads < 2.5 mg/m³, or
- the LEL/O₂ meter reads > 19.5 percent.

Modified Level D is required if:

- the FID reads > background at the source but < 25 ppm in the breathing zone, and
- the benzene 0.5/c Draeger tube reads < or equal to 0.5 ppm, or
- the RDM reads < 2.5 mg/m³, or
- the LEL/O₂ meter reads > 19.5 percent.

Level C is required if:

- the FID reads between 25 and 170 ppm, and/or
- the benzene 0.5/c Draeger tube reads between 0.5 and 10 ppm,
- the RDM reads ≥ 2.5 mg/m³, or
- the LEL/O₂ meter reads > 19.5 percent.

Level B is required if:

- the FID reads ≥ 170 ppm, or
- the benzene 0.5/c Draeger tube reads ≥ 10 ppm, or
- the LEL/O₂ meter reads < 19.5 percent

In addition, stop work and evacuate the site if:

- the RDM reads > 5 mg/m³,
- the LEL/O₂ meter reads ≥ 20 percent.

Levels of protection for work at PSCs 3 and 42

Level D is acceptable if:

- the work is nonintrusive,
- the FID reads less than or equal to background at the source but < 25 ppm in the breathing zone, and
- the benzene 0.5/c Draeger tube reads < 0.5 ppm, or
- the RDM reads < 0.21 mg/m³, or
- the LEL/O₂ meter reads > 19.5 percent.

Modified Level D is required if:

- the work is intrusive (level D is acceptable if the work is nonintrusive),
- the FID reads $<$ or $=$ 25 ppm, and
- the benzene 0.5/c Draeger tube reads $<$ or equal to 0.5 ppm, or
- the RDM reads $<$ 0.21 mg/m³, or
- the LEL/O₂ meter reads $>$ 19.5 percent.

Level C is required if:

- the FID reads between 25 and 170 ppm, and/or
- the benzene 0.5/c Draeger tube reads between 0.5 and 10 ppm,
- the RDM reads \geq 0.21 mg/m³, or
- the LEL/O₂ meter reads $>$ 19.5 percent.

Level B is required if:

- the FID reads \geq 170 ppm, or
- the benzene 0.5/c Draeger tube reads \geq 10 ppm, or
- the LEL/O₂ meter reads $<$ 19.5 percent.

In addition, stop work and evacuate the site if:

- the RDM reads $>$ 5 mg/m³, or
- the LEL/O₂ meter reads \geq 20 percent.

3.4.2 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 at PSCs 42, 43, and 3. Personnel who conduct a high risk work task will be noted in field logs. This subsection gives a description of the personal monitoring equipment that may be used as well as a guide for monitoring for cadmium and chromium. Additional information concerning personal monitoring, if required, is provided in Section 7.2 of the CLEAN program HASP dated March 1991.

3.4.2.1 Personal Monitoring Equipment The following personal monitoring equipment will be used at the site. Use, maintenance, and calibration of this equipment will be done in accordance with the manufacturers' specifications.

- Gillian pump, with 37-millimeter (mm), three-piece, 0.8-micron, mixed cellulose-ester acetate (MCE) filter cassettes
- thermoluminescent dosimetry body badges, to be used by workers as required

3.4.2.2 Guidance for Personal Monitoring for Cadmium and Chromium As indicated in Chapter 2.0 of this HASP, the COCs known or suspected to be present onsite may include cadmium and chromium. Below is a description of personal monitoring required based on these specific COCs. These guidelines should be followed when working in areas where these COCs are known or suspected to be present.

Monitoring for Cadmium Personal monitoring will be undertaken to characterize the worker's exposure to cadmium. This will be done by monitoring representative employees for cadmium. Employee selection will be based on work task and duration

of exposure. Sampling and analysis will be done in accordance with National Institute of Occupational Safety and Health (NIOSH) methodology and is summarized in Appendix D of this HASP. The HSS and HSM should be contacted prior to sampling.

Monitoring for Total Chromium Personal monitoring will be undertaken to characterize the worker exposure to chromium. This will be done by monitoring representative employees for chromium. Employee selection will be based on work task and duration of exposure. Sampling and analysis will be done in accordance with NIOSH methodology and is summarized in Appendix D of this HASP. The HSS and HSM should be contacted prior to sampling.

3.5 PERSONAL PROTECTIVE EQUIPMENT (PPE). The level of personal protection will be determined based on the criteria previously defined in Sections 3.3 and 3.4 of this HASP. A description of the basic composition of the generally recognized protective ensembles can be found in Appendix E of the ABB-ES generic HASP dated June 1990. The specific components for any of the defined levels of protection will be selected using that appendix as a guide. Additionally, the specific site hazards and conditions may require the use of specific equipment. This equipment may include respirators and other PPE. A description is given below.

3.5.1 Respirators All workers who wear a cartridge respirator must have been fit-tested within the last year. Fullface cartridge respirators with a high efficiency particulate air (HEPA) dust filter will be used if there is a potential for cadmium levels to be above the action limits previously defined in Section 3.4. If, in addition to cadmium, organics are present at levels that require an upgrade to level C protection, cartridges capable of filtering both cadmium and organics (e.g., [GMC-H] type cartridges) will be used.

Fullface, cartridge respirators with an HEPA dust filter will be used if there is a potential for chromium levels to be above the action limit previously defined in Section 3.4. If, in addition to chromium, organics are present at levels that require an upgrade to level C protection, cartridges capable of filtering both chromium and organics (e.g., GMC type cartridges) will be used.

3.5.2 Other PPE Specific locations and tasks may require the use of distinctive PPE appropriate for that task. These may include, but are not limited to, coveralls, gloves, steel-toed boots, boot covers, hard hats, escape masks, face shields, two-way radios, protective eyewear, and snake guards. Specific components for any level of protection will be selected based on a full assessment of the potential site and activity hazards.

3.6 RECORD KEEPING. Below is a breakdown of records that will be kept for onsite personnel and activities. These include, but are not limited to, personnel documentation, onsite monitoring, and day-to-day records. All records will be made available to associates upon request.

3.6.1 Personnel Documentation Documentation of the following is required for all onsite personnel:

- personal training including all training outlined in 29 CFR 1910.120,
- personal training including all training outlined in 29 CFR 1910.1027,

- medical surveillance including that outlined in Section 1.4, and
- respirator fit testing.

NOTE: The employer must certify that the employees have been trained and fit-tested by providing a certification record of the above. Additionally, within 15 days of request, the medical surveillance records must be made available to the employee.

3.6.2 Onsite Monitoring A copy of any monitoring should be kept by the HSO. The HSM is required to maintain records of all cadmium monitoring conducted. Therefore, a copy of the results of the monitoring will be sent to the HSM. In addition to the results, the following information must be provided.

- A. Dates, number, duration, location, and results of each of the samples taken must be recorded. Included with this must be a description of the sampling procedures used to determine representative employee exposure where applicable.
- B. A description of the sampling and analytical methods used and evidence of their accuracy will be recorded.
- C. The type of respiratory protective devices worn, if any, will be recorded.
- D. The name, social security number, company, and job classification of all employees (or subcontractors) represented by the sample will be recorded.
- E. The environmental variables that could affect the measurement of employee exposure (e.g., cold weather, frozen ground, no wind, warm day, dry soil, or windy) will be recorded.

NOTE: These records will be maintained for the duration of employment plus 20 years, or for 40 years (whichever is longer). Medical surveillance records will also be maintained for the same duration.

3.6.3 Day-to-Day Record Keeping A record of day-to-day activities should be kept by the HSO. This may include, but is not limited to, the following:

- health and safety audit forms,
- summaries of health and safety meetings,
- HSO checklists for field operations,
- Medical Safety Data Sheets (MSDS) for onsite chemicals,
- OSHA's job safety and health protection notice,
- ABB-ES' daily health and safety audit form, and
- accident report forms.

In addition, a copy of the appropriate and required documentation will be provided to the HSS and HSM.

4.0 SITE CONTROL

4.1 ZONATION. The general zonation protocols that should be employed at hazardous waste sites are described in Chapter 8.0 of the CLEAN program HASP dated March 1991. Due to the nature of the work and the properties of the potential chemicals found onsite, typical stationary exclusion, contamination reduction, and support zones are not necessary or practical at all locations. Therefore, where appropriate, 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 moved accordingly as the assessment points are moved.

Zonation for waste sites and "floating" decontamination stations are described in the ABB-ES generic HASP in Part II, Appendix G and Appendix L. A stationary small equipment decontamination area will be established adjacent to the field trailer. A diagram of the decontamination pad is provided in the OU 2 field sampling plan. 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.).

4.2 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 Part II, Appendix H of the ABB-ES generic HASP dated June 1990.

4.3 WORK PRACTICES. General work practices to be used during the OU 2 RI activities are described in Chapter 9.0 of the CLEAN program HASP dated March 1991. Furthermore, workers will be expected to adhere to the established safe work practices for their respective specialties and trades. Weather conditions, protective gear, and peripheral activities can make the need for caution more acute. All work at OU 2 will be conducted according to these established protocols 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 below.

- Work and sampling will be conducted in level D or modified level D clothing and equipment, unless site-specific conditions are discovered that require a higher level of personal protection.
- In any unknown situation, always assume the worst conditions and plan accordingly.

- Smoking, eating, or drinking in the work area and before decontamination will not be allowed.
- Avoid overexertion and heat stress. Work breaks should be planned to prevent stress-related accidents or fatigue. All guidelines outlined in Chapter 12.0 of the CLEAN program HASP should be followed.
- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during the field investigative assignment.

5.0 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 either the "fixed" decontamination station located onsite for work conducted at OU 2 and/or the "floating" decontamination stations as needed. General decontamination practices are described in Chapter 13.0 of the CLEAN program HASP and in Part II of the site-specific HASP in Appendix L.

5.1 PERSONNEL DECONTAMINATION. All personnel leaving the investigation area are subject to decontamination. The decontamination procedures required will be determined by the nature and level of contamination found at the sites. At a minimum, site personnel will remove loose soil from boots and clothing before leaving the site.

All workers MUST shower at the end of the workday if there is a potential for cadmium levels to be above the PEL or if level C protective equipment is required because of the cadmium concentrations. In the event that personal garments are potentially contaminated with materials that contain cadmium, these garments will be bagged and disposed of as described in Section 5.2. In addition, more thorough decontamination procedures will be observed as dictated by site conditions.

5.1.1 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 sampling events. All equipment that is taken out of the exclusion zone of an area where there is a potential for cadmium levels to be elevated will be labeled as follows: "DANGER. CONTAINS CADMIUM. CANCER HAZARD. AVOID CREATING DUST. CAN CAUSE LUNG AND KIDNEY DISEASE." Small equipment decontamination is described in more detail in Chapter 3.0 of the CLEAN program HASP dated March 1991.

5.1.2 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. 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 Chapter 13.0 of the CLEAN program HASP.

5.2 COLLECTION AND DISPOSAL OF DECONTAMINATION PRODUCTS. All disposable protective gear, decontamination fluids (for both personnel and equipment), and other disposable materials will be disposed of at the site. Disposable material (e.g., gloves and Tyvek™ suits) will be bagged and disposed of properly. All PPE possibly contaminated with cadmium will bear the following label: "DANGER. CONTAINS CADMIUM. CANCER HAZARD. AVOID CREATING DUST. CAN CAUSE LUNG AND KIDNEY DISEASES." Collection and disposal of decontamination products are described in more detail in Chapter 13.0 of the CLEAN program HASP.

6.0 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 in Part II, Appendix M of the ABB-ES HASP. The following subSections present site-specific emergency and contingency planning information.

6.1 EMERGENCY MEDICAL SERVICES AND FIRST AID. Prior to beginning the RI, contact will be made with the local medical facilities to ensure that emergency department physician coverage, decontamination capabilities, and available medical specialists will be available. The hospital will also be briefed on the availability of personnel health data and technical support through Environmental Medical Resources, Inc.

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 would be by means of professional emergency transportation; 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.

Onsite first aid equipment will include, but is not limited to, an industrial first-aid kit and an eye-wash station. At least one person qualified to perform first aid will be present onsite at all times during work activities.

6.2 CONTINGENCY PLANNING. The HSO has overall responsibility for adherence to the designated safety precautions and assumes the role of onsite coordinator in an emergency response situation. In addition, all onsite personnel will be familiar with routes to the hospital. A list of emergency telephone numbers will be posted in the trailer.

Emergency communication will be required to ensure positive preplanned notification of emergency authorities in the event of episodes requiring initiation of contingency plans. This communication is described in Part II, Appendix M, of the ABB-ES generic HASP.

6.3 POTENTIAL HAZARDS. In addition to the site hazards described in Chapter 3.0 of this HASP, other potential hazards commonly associated with hazardous waste sites or specifically associated with OU 2 include (1) accidents, (2) inhalation, contact, or ingestion of hazardous materials, (3) explosions, (4) fire, (5) activities associated with current remedial activities, (6) activities associated with the day-to-day operation of the WWTP, and (7) day-to-day base and taxiway activities.

6.3.1 Accident All accidents will be handled on a case-by-case basis. Whenever possible, decontamination will occur prior to administering any first aid. In the event the person cannot go through the normal decontamination procedures, the

medical facility and emergency medical response personnel will be notified and advised to take proper safety precautions while treating and transporting the victim. If the nature and degree of surface contamination at the location of the injured person is low, emergency vehicles could reach the victim onsite without undue hazard. If the emergency vehicles cannot reach the accident victim, ABB-ES personnel trained for this type of response may transport the person to a location accessible to the emergency vehicle.

6.3.2 Contact and/or Ingestion of Hazardous Materials Although the designated protective equipment is designed and established to minimize contact with hazardous material, it is still possible to contact or ingest materials. In the event that contact or ingestion occurs, standard first aid should be administered. All contaminants should be flushed from the skin and eye washes should be readily available for use as needed. In case of ingestion or significant contact with a **known** substance, the local Poison Control Center and hospital should be notified and the victim taken there immediately for further treatment and observation.

6.3.3 Explosion When possible, explosion hazards should be identified prior to beginning work. This may include use of meters to detect potentially explosive atmospheres, such as an LEL meter, and use of equipment that is explosion-proof or intrinsically safe and nonsparking bronze, brass, or aluminum tools.

6.3.4 Fire A portable fire extinguisher will be available in the event small fires occur. The appropriate fire extinguisher should be used according to the type of burning materials it was designed to extinguish. If a fire starts, workers should leave the area, unless they have been assigned fire-fighting responsibilities. The fire department should be contacted immediately so that properly trained and equipped firefighters can handle the situation.

6.3.5 Activities Associated with Current Remedial Activities The remedial activities currently transpiring and scheduled at OU 2 can present a variety of potential hazards. Communication with the Remedial Action Contractor's (RAC's) HSO will occur on a routine basis to coordinate onsite activities.

6.3.6 Activities Associated with the Day-to-Day Operation of the WWTP The day-to-day operations of the WWTP can present unique hazards. These include chlorine gas leaks, biological hazards, and equipment hazards. Personnel should not enter the WWTP or any of its treatment units immediately. Communication with WWTP personnel should occur to coordinate activities and understand further the potential hazards and contingencies associated with the WWTP.

6.3.7 Day-to-Day Base and Taxiway Activities At no time should any personnel interfere with base operations. This includes avoiding restricted areas such as the taxiways, the present firefighting training area, and any other area determined to be or marked as restricted.

6.4 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.

6.5 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 determination of conditions warranting 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 outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office (if upwind) or the designated rally point to assess the situation. The respirators may then be removed (if instrumentation indicates an acceptable condition). As additional information is gathered by the field crew, it will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the HSO.

7.0 ADMINISTRATION

7.1 PERSONNEL AUTHORIZED DOWNRANGE. Personnel authorized to participate in downrange activities at this site have been reviewed and certified for site operations by the Project Manager 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 Site Manager and/or HSO before going downrange.

CERTIFIED ABB-ES TEAM PERSONNEL:

Kelly Murray *+	Field Operations Lead
Elizabeth Messer *+	Health and Safety Officer
Brandon Raye *+	Field Technician
Ann-Marie Weaver *+	Project Assistant
Janet Burris	Senior Risk Assessor
Mark Kauffman	Senior Engineer/Technical Lead
Jesse Tremaine *+	Technical Expert
Fredrick Bragdon *+	Technical Expert/Technical Lead

* FIRST-AID TRAINED
+ CPR-TRAINED

7.2 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.

_____ Date
Health and Safety Officer

_____ Date
Project Manager

_____ Date
Health and Safety Manager

_____ Date
Health and Safety Supervisor

7.3 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: _____

7.4 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 () _____

7.5 EMERGENCY TELEPHONE NUMBERS.

NAS Jacksonville

Police Department	911
Rescue Service	911
Orange Park Medical	(904) 267-8580
St. Vincents Hospital	(904) 387-7395
Riverside Hospital	(904) 387-7070
NAS Jacksonville Police	(904) 772-2661
NAS Jacksonville Fire station and Spill Response	(904) 772-3333

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: Elizabeth Messer	
Task Order Manager: Peter Redfern	(904) 656-1293
Regional HSS: DeBorah Wilder	(904) 656-1293
ABB Environmental HSM: Cindy Sundquist	(800) 341-0460 ext. 2657

EMERGENCY CONTACTS

Dr. David Barnes	(800) 229-3674
ABB-ES (Maine)	(800) 476-0460
ABB-ES (Florida)	(904) 656-1293
USEPA Emergency Response	(800) 414-8802

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

Facility Name: Orange Park Medical

Address: 2001 Kingsley Avenue, Orange Park, FL.

Telephone Number: (904) 276-8580

Directions to primary source of medical assistance: (Figure 7-1)

Exit NAS via the main gate and take a left onto Roosevelt Boulevard (Highway 17) heading south. Proceed south to Kingsley Avenue and take a right heading west onto Kingsley Avenue. Proceed approximately 2 miles to Orange Park Medical Hospital (on right).

First alternative source of medical assistance:

Facility Name: St. Vincents Hospital

Address: 1800 Barrs Street, Jacksonville, FL

Telephone Number: (904) 387-7395

Directions to first alternate source of medical assistance: (Figure 7-1)

Exit NAS via the main gate and take a right onto Roosevelt Boulevard (Highway 17) heading north. Proceed north to Park Street and take a right (east) onto Park Street. Proceed on Park Street to Barrs Street and take a right. At the end of Barrs Street, on the right, is St. Vincents Hospital.

Second alternative source of medical assistance:

Facility Name: Riverside Hospital

Address: 2033 Riverside Avenue, Jacksonville, FL

Telephone Number: (904) 387-7070

Directions to second alternate source of medical assistance: (Figure 7-1)

Exit NAS via the main gate and take a right onto Roosevelt Boulevard (Highway 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. Proceed on Margaret Street to Riverside. Riverside Hospital is on the Corner of Margaret Street and Riverside.

APPENDIX A

TRAINING REQUIREMENTS FOR THE CADMIUM STANDARD

Training Requirements for the Cadmium Standard

All workers with a potential for exposure to airborne cadmium must receive training on the Cadmium Standard (29 Code of Federal Regulations (CFR) Part 1910.1027). A record must be maintained of the contents of the training program. The training will be provided prior to the start of the job and annually thereafter.

The training program will included the following:

1. health hazards associated with cadmium exposure, with special attention to the information in Appendix A of the Cadmium Standard;
2. the quantity, location, manner of use, release, and storage of cadmium in the workplace;
3. engineering controls;
4. measures that can be taken to protect oneself from exposure to cadmium;
5. the purpose, selection, fitting, and limitations of PPE and respirators;
6. the purpose and description of the medical surveillance program; and
7. the contents of Section 29 CFR 1910.1027(m)(4) and its appendices.

APPENDIX B

MEDICAL SURVEILLANCE FOR CADMIUM AND CHROMIUM

Medical Surveillance for Cadmium and Chromium

All medical surveillance provided by the employer must be done in accordance with the criteria outlined in 29 Code of Federal Regulations (CFR) Part 1910.1027. The specific requirements outlined in 29 CFR 1910.1027 supersede any information given in this appendix.

As outlined in *Occupational Exposure to Cadmium (OSHA 3136, 1992)*, published by the U.S. Department of Labor, the employer must provide medical surveillance for all employees who are exposed or have the potential to be exposed to cadmium and chromium above the permissible exposure limit (PEL). The provisions for medical monitoring include (1) providing medical examinations and biological monitoring tests; (2) taking any necessary corrective actions required by monitoring results; (3) ensuring that medical procedures meet Occupational Safety and Health Administration (OSHA) recommendations and that employees are allowed to use multiple physician reviews and alternative medical determination procedures, if needed; and (4) giving to and obtaining from physicians the necessary information and data to evaluate an employee's health status.

At a minimum, medical surveillance provisions require an initial limited pre-placement examination, a periodic full medical examination within 1 year after the initial examination and biennially thereafter, and annual biological monitoring. The three required biological monitoring tests are urine, blood, and beta-2-macroglobulin in urine. The recommended employer actions triggered by the results of biological monitoring are identified in Appendix A of 29 CFR 1910.1027.

Medical examination and biological monitoring results may require employers to reassess factors such as work practices, personal hygiene, smoking history and status, respiratory protection, hygiene facilities, PPE, and engineering controls and correct any deficiencies responsible for excess exposures.

All medical examinations and procedures required by this rule will be performed under the supervision of a licensed physician (medical doctor) who has read and is familiar with the health information provided in the preamble of the rule, the regulatory text, and Appendices A, D, and F of the rule. Examinations and procedures must be provided without cost to, and at a time and place that is reasonable for, the employee.

Employers must notify employees of their right to seek a second medical opinion after completion of the initial medical examination or consultation. The employer and employee may agree upon the use of any alternate form of physician determination, in lieu of more than one medical opinion (multiple physician review), as long as the alternative is expeditious and equally as protective.

The employer must obtain a written, signed, medical opinion from the examining physician that, to the extent relevant to the employee's exposure to cadmium, includes the following: (1) the physician's diagnosis and any opinion on the status of the employee's medical condition that would place the employee at increased risk from further exposure to cadmium, (2) the results of any employee tests that reveal cadmium exposure, (3) any limitations on the employee work activities, and (4) a statement by the physician that he or she has clearly and carefully explained the important medical facts to the employee.

Employers must temporarily remove employees from jobs with exposure to cadmium at or above the action limit (AL) on each occasion that a physician determines in a written medical opinion that the employee should be removed from cadmium exposure, or where the employee's biological monitoring results are so high as to require medical removal. The physician may determine the need for medical removal based on biological monitoring results, evidence of illness, inability to wear a respirator, signs or symptoms of cadmium-related dysfunction or disease, or any other reason deemed medically sufficient. When the removal is due to the employee's inability to wear a respirator, the removal need only be from jobs with exposure to cadmium above the PEL.

The employer also must provide employees with the following:

- a copy of the physician's written medical opinion within 2 weeks after receipt,
- a copy of the employee's biological monitoring results within 2 weeks after receipt, and
- information that is given to the physician under the provisions of this rule within 30 days of an employee's request.

The employer also must establish and maintain an accurate medical surveillance record for each employee to whom medical surveillance is provided. The medical surveillance record must include the following information:

- the name, social security number, and description of the duties of the employee;
- a copy of the physician's written opinion;
- a copy of the employee's medical history, the results of any physical examination, and all test results that must be provided by this rule including biological tests, X-rays, and pulmonary function tests and any results that have been obtained to further evaluate any condition that might be related to cadmium exposure;
- the employee's medical symptoms that might be related to exposure to cadmium; and
- a copy of the information provided to the physician as required under this rule.

In accordance with the provisions of 29 CFR 1910.120, the employer must retain the medical surveillance records for the duration of the employee's employment plus 30 years.

The employer must make available either to the employee, or to anyone having the written consent of the employee, within 15 days after a request, all required medical records. After an employee's death or incapacitation such records also must be given within 15 days of a request to the employee's family.

Similarly, the employer is responsible for the proper transfer of these records when he or she ceases to do business.

APPENDIX C
CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM (CHRIS)
DATA SHEETS

ARSENIC

ARX

<p>Common Synonyms</p> <p>Arsenic, solid Arsenic, metallic Gray arsenic</p>	<p>Solid crystals Gray</p> <p>Sinks in water.</p>
<p>AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY. Wear self-contained positive pressure breathing apparatus and full protective clothing. Stay upwind and use water spray to "knock down" dust. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<p>Fire</p>	<p>Can be heated to burn in air. POISONOUS GASES ARE PRODUCED IN FIRE. Wear self-contained positive pressure breathing apparatus and full protective clothing. Extinguish small fires: dry chemical, carbon dioxide, water spray or foam; large fires: water spray, fog or foam.</p>
<p>Exposure</p>	<p>CALL FOR MEDICAL AID.</p> <p>DUST POISONOUS IF INHALED. Move victim to fresh air. IF IN EYES OR ON SKIN, immediately flush with running water for at least 15 minutes; hold eyelids open if necessary. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>SOLID POISONOUS IF SWALLOWED. IF IN EYES OR ON SKIN, flush with running water for at least 15 minutes; hold eyelids open if necessary. IF SWALLOWED and victim is CONSCIOUS and has not vomited, induce vomiting with syrup of ipecac. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>
<p>Water Pollution</p>	<p>Effects 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.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning - poison. Restrict access. Should be removed. Chemical and physical treatment.</p>	<p>2. LABEL</p> <p>2.1 Category: Poison 2.2 Class: 6</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Not listed 3.2 Formula: As 3.3 IMO/UN Designation: 6.1/1558 3.4 DOT ID No.: 1558 3.5 CAS Registry No.: 7440-38-2</p>	<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Solid 4.2 Color: Silver-gray 4.3 Odor: Data not available</p>
<p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Wear self-contained positive pressure breathing apparatus and full protective clothing. 5.2 Symptoms Following Exposure: Poisonous by inhalation of dust or by ingestion. Regardless of exposure route, symptoms in most cases are characteristic of severe gastritis or gastroenteritis. All chemical forms of arsenic eventually produce similar toxic effects. Symptoms may be delayed. 5.3 Treatment of Exposure: Get medical attention after any exposure to this metal. INHALATION: Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. EYES OR SKIN: Immediately flush with running water for at least 15 minutes; hold eyelids open if appropriate. Use soap and water to clean skin. Remove and isolate contaminated clothing and shoes. INGESTION: If the victim is alert and has not vomited, induce vomiting with syrup of ipecac. 5.4 Threshold Limit Value: 0.2 mg/m³ 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Data not available 5.7 Late Toxicity: Human carcinogen. Causes mutagenic, reproductive and tumorigenic effects along with damage to the gastrointestinal tract and degeneration of the liver and kidneys. 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: Data not available</p>	

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: Not pertinent 6.2 Flammable Limits in Air: Not pertinent 6.3 Fire Extinguishing Agents: Small fires: dry chemical, carbon dioxide, water spray or foam; large fires: water spray, fog or foam. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Contain highly toxic arsenic trioxide and other forms of arsenic. Arsenic gas, the most dangerous form of arsenic, is produced upon contact with an acid or acid fumes. 6.6 Behavior in Fire: Burns to produce dense white fumes of highly toxic arsenic trioxide. 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Data not available <i>(Continued)</i></p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II</p> <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Poison; B 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>3</td> </tr> <tr> <td>Flammability (Red)</td> <td>2</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>	Category	Classification	Health Hazard (Blue)	3	Flammability (Red)	2	Reactivity (Yellow)	0
Category	Classification								
Health Hazard (Blue)	3								
Flammability (Red)	2								
Reactivity (Yellow)	0								
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Incompatible with Zinc. 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</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 74.9216 12.3 Boiling Point at 1 atm: 1,135°F = 613°C = 886°K (sublimes) 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: 1477.4°F = 803°C = 1076.2°K 12.6 Critical Pressure: 5027.4 psia = 342.0 atm = 34.6 MN/m² 12.7 Specific Gravity: 5.727 at 25°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available</p>								
<p>8. WATER POLLUTION</p> <p>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: Bioaccumulated by fresh water and marine aquatic organisms.</p>	<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Crude, 90-95%; Refined, 99%; Semiconductor, 99.999% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: Not listed 9.4 Venting: Not pertinent</p>								
<p>6. FIRE HAZARDS (Continued)</p> <p>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</p>									

ARX

ARSENIC

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
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

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 N S O L U B L E		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

BENZENE

BNZ

Common Synonyms Benzol Benzole		Watery liquid	Colorless	Gasoline-like odor
Floats on water. Flammable; irritating vapor is produced. Freezing point is 42°F.				
Avoid contact with liquid and vapor. Keep people away. Wear goggles and self-contained breathing apparatus. Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		<p>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.</p>		
Exposure		<p>CALL FOR MEDICAL AID</p> <p>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.</p> <p>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.</p>		
Water Pollution		<p>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.</p>		
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Restrict access</p>		<p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p>		
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C₆H₆ 3.3 IMO/UN Designation: 3.2/1114 3.4 DOT ID No.: 1114 3.5 CAS Registry No.: 71-43-2</p>		<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic; rather pleasant aromatic odor, characteristic odor</p>		
<p>5. HEALTH HAZARDS</p> <p>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 irritator 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; LD₅₀ = 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 smearing and reddening of the skin. 5.10 Odor Threshold: 4.68 ppm 5.11 IDLM Value: 2,000 ppm</p>				

<p>6. FIRE HAZARDS</p> <p>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</p>		<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-V-W</p>																																					
<p>7. CHEMICAL REACTIVITY</p> <p>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</p>		<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant.....</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td>1</td> </tr> <tr> <td>Poisons.....</td> <td>3</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity.....</td> <td>3</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td>1</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td>3</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals.....</td> <td>2</td> </tr> <tr> <td>Water.....</td> <td>1</td> </tr> <tr> <td>Self Reaction.....</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td>2</td> </tr> <tr> <td>Flammability (Red).....</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td>0</td> </tr> </tbody> </table>		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	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	3	Reactivity (Yellow).....	0
Category	Rating																																						
Fire.....	3																																						
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Flammability (Red).....	3																																						
Reactivity (Yellow).....	0																																						
<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 5 ppm/6 hr/minnow/lethal/distilled water 20 ppm/24 hr/sunfish/TL₅₀/tap water 8.2 Watertowal Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 1.2 lb/lb, 10 days 8.4 Food Chain Concentration Potential: None</p>		<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 78.11 12.3 Boiling Point at 1 atm: 176°F = 80.1°C = 353.3°K 12.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K 12.5 Critical Temperature: 552.0°F = 286.9°C = 562.1°K 12.6 Critical Pressure: 710 psia = 48.3 atm = 4.89 MN/m² 12.7 Specific Gravity: 0.878 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 10³ J/kg 12.13 Heat of Combustion: -17,460 Btu/lb = -9698 cal/g = -406.0 X 10³ 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</p>																																					
<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Industrial pure 99+ % Theophene-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</p>		<p>NOTES</p>																																					

BNZ

BENZENE

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
55	55.330	45	.394	75	.988	55	.724
60	55.140	50	.396	80	.981	60	.693
65	54.960	55	.398	85	.975	65	.665
70	54.770	60	.400	90	.969	70	.638
75	54.580	65	.403	95	.962	75	.612
80	54.400	70	.405	100	.956	80	.588
85	54.210	75	.407	105	.950	85	.566
90	54.030	80	.409	110	.944	90	.544
95	53.840	85	.411	115	.937	95	.524
100	53.660	90	.414	120	.931	100	.505
105	53.470	95	.416	125	.925	105	.487
110	53.290	100	.418	130	.919	110	.470
115	53.100			135	.912	115	.453
120	52.920			140	.906	120	.438
125	52.730			145	.900		
130	52.540			150	.893		
135	52.360			155	.887		
140	52.170			160	.881		
145	51.990			165	.875		
150	51.800			170	.868		
155	51.620						
160	51.430						
165	51.250						
170	51.060						
175	50.870						

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
77.02	.180	50	.881	50	.01258	0	.204
		60	1.171	60	.01639	25	.219
		70	1.535	70	.02109	50	.234
		80	1.989	80	.02681	75	.248
		90	2.547	90	.03371	100	.261
		100	3.227	100	.04196	125	.275
		110	4.049	110	.05172	150	.288
		120	5.033	120	.06317	175	.301
		130	6.201	130	.07652	200	.313
		140	7.577	140	.09194	225	.325
		150	9.187	150	.10960	250	.337
		160	11.060	160	.12980	275	.349
		170	13.220	170	.15270	300	.360
		180	15.700	180	.17850	325	.371
		190	18.520	190	.20750	350	.381
		200	21.740	200	.23970	375	.392
		210	25.360	210	.27560	400	.402
						425	.412
						450	.421
						475	.431
						500	.440
						525	.449
						550	.457
						575	.465
						600	.474

2-BUTANONE PEROXIDE

BNP

Common Synonyms 2-Butanone, peroxide Methylethylketone peroxide Ethylmethylketone peroxide MEKP, Ketinox Butanox M50, M105, LFT Chaloxyd MEKP-HA 1, -LA 1		Liquid	Colorless	Acetone-like odor
Avoid contact with vapors and liquid. Keep people away. Wear self-contained positive pressure breathing apparatus and full protective clothing. Stay upwind, keep out of low areas. Shut off ignition sources. Call fire department. Stop leak if you can do it without risk. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		COMBUSTIBLE. May be ignited by heat, sparks or flames. Container may explode in heat or fire. Runoff to sewer may create fire or explosion hazard. Fire may produce irritating or poisonous gases. Extinguish fires with dry chemical, CO ₂ , water spray or alcohol foam. For massive fire in cargo area, use unmanned hose holder or monitor nozzles. If fire can be controlled, cool container with water from unmanned hose holder or monitor nozzles until after fire is out. If this is impossible, withdraw from area and let fire burn.		
Exposure		CALL FOR MEDICAL AID. VAPOR Vapor extremely irritating. Contact of vapor with eyes may cause blindness. Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Harmful if swallowed or absorbed through skin. IF IN EYES: hold eyelids open, flush with running water for at least 15 minutes. Flush affected areas with plenty of water. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site. IF SWALLOWED: keep victim quiet and maintain normal body temperature.		
Water Pollution		Effects of low concentrations on aquatic life are not known. May be harmful 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) Evacuate area Issue warning - corrosive Mechanical containment Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Organic Peroxide 2.2 Class: 5.2		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: ((CH ₃) ₂ CHCHOH—O) ₂ 3.3 IMO/UN Designation: 5.2/2550 3.4 DOT ID No.: 2550 3.5 CAS Registry No.: 1338-23-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Acetone-like		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Approved respirator, chemical safety gloves, heavy rubber gloves, chemical safety goggles, rubber boots, protective clothing. 5.2 Symptoms Following Exposure: Extremely destructive to tissue of the mucous membranes, upper respiratory tract, eyes, and skin. Symptoms of exposure include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. 5.3 Treatment of Exposure: EYES: Hold eyelids open, flush with running water for at least 15 minutes. SKIN: Remove contaminated clothing and shoes, flush affected areas with plenty of running water. Wash with soap and water. INGESTION: Call a physician. 5.4 Threshold Limit Value: 0.2 ppm 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 3: LD ₅₀ = 470 mg/kg (mouse) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations. 5.9 Liquid or Solid Irritant Characteristics: Severe skin irritant. Causes second and third degree burns on short contact and is very injurious to the eyes. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available				

6. FIRE HAZARDS	
6.1	Flash Point: 180°F C.C.
6.2	Flammable Limits in Air: Data not available
6.3	Fire Extinguishing Agents: Water spray, dry chemical, CO ₂ , or alcohol foam.
6.4	Fire Extinguishing Agents Not to be Used: Not pertinent
6.5	Special Hazards of Combustion Products: Data not available
6.6	Behavior in Fire: Explosive.
6.7	Ignition Temperature: Data not available
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: Contact with other materials may cause explosion.
7.3	Stability During Transport: Data not available
7.4	Neutralizing Agents for Acids and Caustics: Dry lime, soda ash
7.5	Polymerization: Not pertinent
7.6	Inhibitor of Polymerization: Not pertinent
7.7	Molar Ratio (Reactant to Product): Data not available
7.8	Reactivity Group: Data not available

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

9. SHIPPING INFORMATION	
9.1	Grades of Purity: 50 wt. % in dimethyl phthalate
9.2	Storage Temperature: Refrigerate
9.3	Inert Atmosphere: Data not available
9.4	Venting: Vent periodically

10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-Q-R-S	
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11. HAZARD CLASSIFICATIONS	
11.1	Code of Federal Regulation: Organic Peroxide
11.2	NAS Hazard Rating for Bulk Water Transportation: Category Rating
Fire	1
Health	
Vapor Irritant	4
Liquid or Solid Irritant	4
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	4
Aesthetic Effect	2
Reactivity	
Other Chemicals	4
Water	0
Self Reaction	4
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: 176.22
12.3	Boiling Point at 1 atm: Data not available
12.4	Freezing Point: Data not available
12.5	Critical Temperature: Data not available
12.6	Critical Pressure: Data not available
12.7	Specific Gravity: 1.170 at 20°C
12.8	Liquid Surface Tension: Data not available
12.9	Liquid Water Interfacial Tension: Data not available
12.10	Vapor (Gas) Specific Gravity: 6.08 (est)
12.11	Ratio of Specific Heats of Vapor (Gas): Data not available
12.12	Latent Heat of Vaporization: Data not available
12.13	Heat of Combustion: Data not available
12.14	Heat of Decomposition: 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: Data not available

NOTES

BNP	2-BUTANONE PEROXIDE
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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
	D A T A N O T A V A I L L A B L E		D A T A N O T A V A I L L A B L E		D A T A N O T A V A I L L A B L E		D A T A N O T A V A I L L A B L E

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
	D A T A N O T A V A I L L A B L E		D A T A N O T A V A I L L A B L E		D A T A N O T A V A I L L A B L E		0 0.297 25 0.307 50 0.317 75 0.327 100 0.337 125 0.347 150 0.357 175 0.367 200 0.377 225 0.387 250 0.397 275 0.407 300 0.417 325 0.427 350 0.436 375 0.446 400 0.456 425 0.466 450 0.476 475 0.486 500 0.496 525 0.506 550 0.516 575 0.526 600 0.536

BERYLLIUM

BEM

Common Synonyms	Solid	Silver color	Odorless
Sinks in water.			
<p>AVOID CONTACT WITH SOLID AND DUST, KEEP PEOPLE AWAY. Wear dust respirator and rubber overclothing (including gloves). Stop discharge if possible. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>			
Fire	Combustible. POISONOUS GASES MAY BE PRODUCED IN FIRE. Dust cloud may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry graphite, soda ash, or other inert powder. DO NOT USE WATER ON FIRE.		
Exposure	CALL FOR MEDICAL AID. DUST POISONOUS IF INHALED OR IF SKIN IS EXPOSED. If inhaled will cause coughing or difficult breathing. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-poison, water contaminant Restrict access Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: None 2.2 Class: Not pertinent		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: Be 3.3 IMO/UN Designation: 6.1/1567 3.4 DOT ID No.: 1567 3.5 CAS Registry No.: 7440-41-7	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White 4.3 Odor: None		
5. HEALTH HAZARDS			
5.1 Personal Protective Equipment: Bu. Mines approved respirator; clean work clothes daily; gloves; eye protection 5.2 Symptoms Following Exposure: Any dramatic, unexplained weight loss should be considered as possible first indication of beryllium disease. Dust is extremely toxic when inhaled; symptoms include coughing, shortness of breath, and acute or chronic lung disease. There is no record of illness from ingestion of beryllium. Contact with dust causes conjunctival inflammation of eyes and dermatitis. 5.3 Treatment of Exposure: INHALATION: acute disease may require hospitalization with administration of oxygen; chest x-ray should be taken immediately. EYES: flush with water for at least 15 min. SKIN: flush with water; wash with soap and water; all cuts, scratches or other injuries should receive prompt medical attention. 5.4 Threshold Limit Value: 0.002 mg/m ³ 5.5 Short Term Inhalation Limits: 0.025 mg/m ³ , less than 30 min. 5.6 Toxicity by Ingestion: Grade 3; oral LD ₅₀ = 100 mg/kg (mouse) 5.7 Late Toxicity: Berylliosis of lungs may occur from 3 months to 15 years after exposure. Chronic systemic diseases of the liver, spleen, lymph nodes, bone, kidney, and other organs may also occur. 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Odorless 5.11 IDLH Value: Data not available			

6. FIRE HAZARDS

6.1 Flash Point: Not pertinent
 6.2 Flammable Limits in Air: Not pertinent
 6.3 Fire Extinguishing Agents: Graphite, sand, or any other inert dry powder
 6.4 Fire Extinguishing Agents Not to be Used: Water
 6.5 Spectral Hazards of Combustion
 Products: Combustion yields beryllium oxide fume, which is toxic if inhaled.
 6.6 Behavior in Fire: Powder may form explosive mixture with air.
 6.7 Ignition Temperature: Not pertinent
 6.8 Electrical Hazard: Not pertinent
 6.9 Burning Rate: Not pertinent
 6.10 Adiabatic Flame Temperature: Data not available
 6.11 Stoichiometric Air to Fuel Ratio: Data not available
 6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
 7.2 Reactivity with Common Materials: Data not available
 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): Data not available
 8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Grade AA, 99.96 + %; Grade A, 99.87 + %; Nuclear grade
 9.2 Storage Temperature: Ambient
 9.3 Inert Atmosphere: No requirement
 9.4 Venting: Open

10. HAZARD ASSESSMENT CODE
 (See Hazard Assessment Handbook)
 II

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).....	4
Flammability (Red).....	1
Reactivity (Yellow).....	0

*Applies to dust or powder.

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
 12.2 Molecular Weight: 9.01
 12.3 Boiling Point at 1 atm: Not pertinent
 12.4 Freezing Point: Not pertinent
 12.5 Critical Temperature: Not pertinent
 12.6 Critical Pressure: Not pertinent
 12.7 Specific Gravity: 1.85 at 20°C (solid)
 12.8 Liquid Surface Tension: Not pertinent
 12.9 Liquid Water Interfacial Tension: Not pertinent
 12.10 Vapor (Gas) Specific Gravity: Not pertinent
 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
 12.12 Latent Heat of Vaporization: Not pertinent
 12.13 Heat of Combustion: -28,000 Btu/lb = -15,560 cal/g = -652 X 10³ 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: 260.0 cal/g
 12.26 Limiting Value: Data not available
 12.27 Reid Vapor Pressure: Data not available

NOTES

BEM**BERYLLIUM**

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
	N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

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 N S O L U B L E		N O T P E R T I N E N T		N O T P E R T I N E N T		N O T P E R T I N E N T

BUTYL BENZYL PHTHALATE

BPH

Common Synonyms Benzyl n-butyl phthalate Phthalic acid, benzyl butyl ether		Liquid	Colorless	Slight odor
Sinks in water.				
Stop discharge if possible. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Combustible. Irritating gases may be produced when heated. Extinguish with dry chemicals, alcohol foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.		
Exposure		CALL FOR MEDICAL AID. LIQUID Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty 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: Ester 3.2 Formula: C ₁₄ H ₁₈ O ₄ 3.3 IMO/IUN Designation: Not listed 3.4 DOT ID No.: Data not available 3.5 CAS Registry No.: 85-68-7		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Slight characteristic		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Protective gloves and goggles 5.2 Symptoms Following Exposure: Prolonged contact with liquid causes some irritation of eyes and skin. 5.3 Treatment of Exposure: EYES: flush with water for 15 min. SKIN: wash well with soap and water. 5.4 Threshold Limit Value: Data not available 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Grade 1; oral rat LD ₅₀ = 13,500 mg/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to eyes and throat. 5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard; practically harmless to skin. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available				

6. FIRE HAZARDS 6.1 Flash Point: 390°F O.C. 6.2 Flammable Limits in Air: Data not available 6.3 Fire Extinguishing Agents: Dry chemical, carbon dioxide, foam 6.4 Fire Extinguishing Agents Not to be Used: Water or foam may cause frothing 6.5 Special Hazards of Combustion Products: Irritating vapors of unburned chemical may form in fires. 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: Data not available 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		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X																																					
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 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		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Not listed 11.2 NAS Hazard Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>1</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>0</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>0</td> </tr> <tr> <td>Poisons</td> <td>0</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>0</td> </tr> <tr> <td>Aesthetic Effect</td> <td>1</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>3</td> </tr> <tr> <td>Water</td> <td>1</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> 11.3 NFPA Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>1</td> </tr> <tr> <td>Flammability (Red)</td> <td>1</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>		Category	Rating	Fire	1	Health		Vapor Irritant	0	Liquid or Solid Irritant	0	Poisons	0	Water Pollution		Human Toxicity	1	Aquatic Toxicity	0	Aesthetic Effect	1	Reactivity		Other Chemicals	3	Water	1	Self Reaction	0	Category	Classification	Health Hazard (Blue)	1	Flammability (Red)	1	Reactivity (Yellow)	0
Category	Rating																																						
Fire	1																																						
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Health Hazard (Blue)	1																																						
Flammability (Red)	1																																						
Reactivity (Yellow)	0																																						
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		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 313 12.3 Boiling Point at 1 atm: 698°F = 380°C = 643°K 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.12 at 20°C (liquid) 12.8 Liquid Surface Tension: Data not available 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Data not available 12.13 Heat of Combustion: -14,550 Btu/lb = -8,090 cal/g = -338 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Low																																					
9. SHIPPING INFORMATION 9.1 Grades of Purity: Commercial 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open		NOTES																																					

BPH

BUTYL BENZYL PHTHALATE

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 (estimate)	Temperature (degrees F)	British thermal unit per pound-F (estimate)	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F (estimate)	Temperature (degrees F)	Centipoise
52	70.469	51	.500	51	1.048	70	24.590
54	70.400	52	.500	52	1.048	75	22.160
56	70.330	53	.500	53	1.048	80	20.020
58	70.259	54	.500	54	1.048	85	18.120
60	70.190	55	.500	55	1.048	90	16.420
62	70.120	56	.500	56	1.048	95	14.910
64	70.049	57	.500	57	1.048	100	13.570
66	69.980	58	.500	58	1.048	105	12.360
68	69.910	59	.500	59	1.048	110	11.280
70	69.839	60	.500	60	1.048	115	10.320
72	69.770	61	.500	61	1.048	120	9.445
74	69.700	62	.500	62	1.048	125	8.661
76	69.639	63	.500	63	1.048	130	7.953
78	69.570	64	.500	64	1.048	135	7.314
80	69.500	65	.500	65	1.048	140	6.736
82	69.429	66	.500	66	1.048	145	6.211
84	69.360	67	.500	67	1.048	150	5.736
86	69.290	68	.500	68	1.048	155	5.303
		69	.500	69	1.048	160	4.910
		70	.500	70	1.048	165	4.551
		71	.500	71	1.048	170	4.223
		72	.500	72	1.048	175	3.924
		73	.500	73	1.048	180	3.650
		74	.500	74	1.048	185	3.399
		75	.500	75	1.048	190	3.169
		76	.500	76	1.048		

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
86	.000	320	.005	320	.00020		D
		340	.010	340	.00037		A
		360	.018	360	.00063		T
		380	.031	380	.00107		A
		400	.052	400	.00176		
		420	.085	420	.00282		N
		440	.137	440	.00444		O
		460	.216	460	.00685		T
		480	.334	480	.01037		
		500	.507	500	.01542		A
		520	.757	520	.02254		V
		540	1.113	540	.03245		A
		560	1.610	560	.04603		I
		580	2.296	580	.06440		L
		600	3.232	600	.08893		A
		620	4.491	620	.12130		B
		640	6.167	640	.16350		L
		660	8.373	660	.21810		E
		680	11.250	680	.28780		

CHLORDANE

CDN

Common Synonyms Chlordane 1, 2, 4, 5, 6, 7, 8, 8-octachloro-2, 3, 3a, 4, 7, 7a-hexahydro-4, 7-methanonene Toxichlor, Octa-klor, Velsicol 1055		Liquid Brown Sharp odor
Sinks in water.		
AVOID CONTACT WITH LIQUID. KEEP PEOPLE AWAY. Wear goggles, self-contained breathing apparatus and rubber overclothing (including gloves). Stop discharge if possible. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	Not flammable but solution may be combustible. POISONOUS GASES MAY BE PRODUCED IN FIRE. Extinguish with dry chemicals, foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.	
Exposure	CALL FOR MEDICAL AID. LIQUID OR SOLUTION POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED. Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-poison Restrict access Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: C ₁₀ H ₆ Cl ₈ 3.3 IMO/UN Designation: 6.1/2762 3.4 DOT ID No.: 2762 3.5 CAS Registry No.: 57-74-9		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Brown 4.3 Odor: Penetrating, aromatic, slightly pungent, like chlorine
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Respirator for sprays, fogs, or dust; goggles; rubber gloves. 5.2 Symptoms Following Exposure: Moderately irritating to eyes and skin. Ingestion, absorption through skin, or inhalation of mist or dust may cause excitability, convulsions, nausea, vomiting, diarrhea, and some local irritation of the gastrointestinal tract. 5.3 Treatment of Exposure: INHALATION: administer oxygen and give fluid therapy; do not give epinephrine, since it may induce ventricular fibrillation, enforce complete rest. EYES: flush with water for at least 15 min. SKIN: wash off skin with adequate quantities of soap and water; do NOT scrub. INGESTION: induce vomiting and follow with gastric lavage and administration of saline cathartics; ether and barbiturates may be used to control convulsions; oxygen and fluid therapy are also recommended; do NOT give epinephrine. Since no specific antidotes are known, symptomatic therapy must be accompanied by complete rest. 5.4 Threshold Limit Value: 0.5 mg/m ³ 5.5 Short Term Inhalation Limit: 2 mg/m ³ for 30 min. 5.6 Toxicity by Ingestion: Grade 3, oral LD ₅₀ = 283 mg/kg (rat) 5.7 Late Toxicity: Possible liver damage; loss of appetite and weight. 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: 500 mg/m ³		

6. FIRE HAZARDS 6.1 Flash Point: Solution 225°F O.C., 132°F C.C. Solid is not flammable 6.2 Flammable Limits in Air: 0.7%-5% (kerosene solution) 6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective on solution fire 6.5 Special Hazards of Combustion: Products: Irritating and toxic hydrogen chloride and phosgene gases may be formed when kerosene solution of compound burns. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 410°F (kerosene solvent) 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: Not pertinent (Continued)		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable to 160°F 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		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Combustible liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed
8. WATER POLLUTION 8.1 Aquatic Toxicity: 0.5 ppm/96 hr/goldfish/TL ₅₀ /fresh water 8.2 Waterfowl Toxicity: LD ₅₀ = 1,200 mg/kg 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: High		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 405.8 12.3 Boiling Point at 1 atm: Decomposes 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.6 at 25°C (liquid) 12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C 12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: (est.) -4,000 Btu/lb = -2,200 cal/g = -93 x 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available
9. SHIPPING INFORMATION 9.1 Grades of Purity: Technical. A variety of dusts, powders, and solutions in kerosene containing 2-80% chlordane are shipped. 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester)		*Properties refer to undiluted, technical-grade chlordane.
6. FIRE HAZARDS (Continued) 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		

CDN

CHLORDANE

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 (estimate)	Temperature (degrees F)	British thermal unit per pound-F (estimate)	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F (estimate)	Temperature (degrees F)	Centipoise (estimate)
52	100.400	60	.300	60	1.209	130	58.980
54	100.400	61	.300	61	1.209	140	51.140
56	100.299	62	.300	62	1.209	150	44.560
58	100.200	63	.300	63	1.209	160	38.990
60	100.200	64	.300	64	1.209	170	34.270
62	100.099	65	.300	65	1.209	180	30.240
64	100.000	66	.300	66	1.209	190	26.780
66	99.940	67	.300	67	1.209	200	23.810
68	99.879	68	.300	68	1.209	210	21.240
70	99.809	69	.300	69	1.209	220	19.020
72	99.740	70	.300	70	1.209	230	17.080
74	99.669	71	.300	71	1.209	240	15.390
76	99.599	72	.300	72	1.209	250	13.900
78	99.530	73	.300	73	1.209	260	12.590
80	99.459	74	.300	74	1.209	270	11.440
82	99.389	75	.300	75	1.209	280	10.420
84	99.320	76	.300	76	1.209	290	9.516
86	99.250	77	.300	77	1.209	300	8.710

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	215	.000	215	.00001		N
	N	220	.000	220	.00001		O
	S	225	.000	225	.00002		T
	O	230	.000	230	.00002		
	L	235	.001	235	.00003		P
	U	240	.001	240	.00005		E
	B	245	.001	245	.00007		R
	L	250	.002	250	.00009		T
	E	255	.002	255	.00012		I
		260	.003	260	.00017		N
		265	.004	265	.00023		E
		270	.006	270	.00031		N
		275	.008	275	.00042		T
		280	.011	280	.00056		
		285	.015	285	.00074		
		290	.019	290	.00099		
		295	.026	295	.00131		
		300	.035	300	.00174		
		305	.046	305	.00228		
		310	.060	310	.00300		
		315	.079	315	.00391		
		320	.104	320	.00510		
		325	.136	325	.00662		
		330	.177	330	.00856		
		335	.230	335	.01104		
		340	.297	340	.01418		

CRESOLS

CRS

<p>Common Synonyms</p> <p>Cresylic acids Hydroxytoluenes Methylphenols Oxytoluenes Tar acids</p>	<p>Watery liquid, or solid Crystals Colorless or yellow Sweet tarry odor</p> <p>Sinks in water.</p>
<p>Avoid contact with liquid. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Stop discharge if possible. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
Fire	<p>Combustible. POISONOUS GASES MAY BE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with water, dry chemical, foam or carbon dioxide. Cool exposed containers with water.</p>
Exposure	<p>CALL FOR MEDICAL AID. LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
Water Pollution	<p>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.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-water contaminant, poison Restrict access Should be removed Chemical and physical treatment</p>	<p>2. LABEL 2.1 Category: Corrosive 2.2 Class: 8</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Phenols, Cresols 3.2 Formula: C₆H₄(OH)₂ 3.3 IMO/UN Designation: 9.0/2076 3.4 DOT ID No.: 2076 3.5 CAS Registry No.: 1319-77-3</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid or solid 4.2 Color: Colorless to dark yellow 4.3 Odor: Sweet, tarry</p>
<p style="text-align: center;">5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Organic vapor canister unit (USBM Type B) approved by U.S. Bureau of Mines. Rubber gloves; chemical safety goggles; face shield; coveralls and/or rubber apron; rubber shoes or boots.</p> <p>5.2 Symptoms Following Exposure: Vapors cause irritation of eyes, nose, and throat. Contact with skin or eyes causes severe burns. Chemical is rapidly absorbed through skin.</p> <p>5.3 Treatment of Exposure: Call a physician. INHALATION: remove to fresh air. INGESTION: have victim drink water or milk; do NOT induce vomiting. SKIN OR EYES: flush immediately with plenty of water for at least 15 min.; remove contaminated clothing immediately and wash before reuse; discard contaminated shoes.</p> <p>5.4 Threshold Limit Value: 5 ppm</p> <p>5.5 Short Term Inhalation Limit: Data not available</p> <p>5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 5 g/kg (rat, rabbit)</p> <p>5.7 Late Toxicity: Data not available</p> <p>5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.</p> <p>5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant; may cause pain and second-degree burns after a few minutes' contact.</p> <p>5.10 Odor Threshold: 5 ppm</p> <p>5.11 IDLH Value: 250 ppm</p>	

<p style="text-align: center;">6. FIRE HAZARDS</p> <p>6.1 Flash Point: 175-185°F O.C.; 178°F C.C.</p> <p>6.2 Flammable Limits in Air: LEL: 1.4% (ortho); 1.1% (meta or para)</p> <p>6.3 Fire Extinguishing Agents: Water, dry chemical, carbon dioxide, and foam</p> <p>6.4 Fire Extinguishing Agents Not to be Used: Not pertinent</p> <p>6.5 Special Hazards of Combustion: Products: Flammable toxic vapors given off in a fire.</p> <p>6.6 Behavior in Fire: Sealed closed containers can build up pressure if exposed to heat</p> <p>6.7 Ignition Temperature: 1110°F (o-cresol) 1038°F (m- or p-cresol)</p> <p>6.8 Electrical Hazard: Data not available</p> <p>6.9 Burning Rate: Data not available</p> <p>6.10 Adiabatic Flame Temperature: Data not available</p> <p style="text-align: right;"><i>(Continued)</i></p>	<p style="text-align: center;">10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-Q-T-U-X-Y</p> <p style="text-align: center;">11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Corrosive material</p> <p>11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td> Vapor Irritant.....</td> <td style="text-align: right;">2</td> </tr> <tr> <td> Liquid or Solid Irritant.....</td> <td style="text-align: right;">3</td> </tr> <tr> <td> Poisons.....</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td> Human Toxicity.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td> Aquatic Toxicity.....</td> <td style="text-align: right;">3</td> </tr> <tr> <td> Aesthetic Effect.....</td> <td style="text-align: right;">4</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td> Other Chemicals.....</td> <td style="text-align: right;">2</td> </tr> <tr> <td> Water.....</td> <td style="text-align: right;">0</td> </tr> <tr> <td> Self Reaction.....</td> <td style="text-align: right;">0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: center;">Classification</th> <th style="text-align: right;">meta</th> <th style="text-align: right;">ortho</th> <th style="text-align: right;">para</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td style="text-align: center;">3</td> <td style="text-align: right;">3</td> <td></td> <td></td> </tr> <tr> <td>Flammability (Red).....</td> <td style="text-align: center;">2</td> <td style="text-align: right;">1</td> <td></td> <td></td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td style="text-align: center;">0</td> <td style="text-align: right;">0</td> <td></td> <td></td> </tr> </tbody> </table>	Category	Rating	Fire.....	1	Health		Vapor Irritant.....	2	Liquid or Solid Irritant.....	3	Poisons.....	2	Water Pollution		Human Toxicity.....	1	Aquatic Toxicity.....	3	Aesthetic Effect.....	4	Reactivity		Other Chemicals.....	2	Water.....	0	Self Reaction.....	0	Category	Classification	meta	ortho	para	Health Hazard (Blue).....	3	3			Flammability (Red).....	2	1			Reactivity (Yellow).....	0	0		
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<p style="text-align: center;">7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction</p> <p>7.2 Reactivity With Common Materials: No reaction</p> <p>7.3 Stability During Transport: Stable</p> <p>7.4 Neutralizing Agents for Acids and Caustics: Not pertinent</p> <p>7.5 Polymerization: Not pertinent</p> <p>7.6 Inhibitor of Polymerization: Not pertinent</p> <p>7.7 Molar Ratio (Reactant to Product): Data not available</p> <p>7.8 Reactivity Group: 21</p>	<p style="text-align: center;">12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid</p> <p>12.2 Molecular Weight: 108.13</p> <p>12.3 Boiling Point at 1 atm: >350°F = >177°C = >450°K</p> <p>12.4 Freezing Point: Varies with composition</p> <p>12.5 Critical Temperature: Not pertinent</p> <p>12.6 Critical Pressure: Not pertinent</p> <p>12.7 Specific Gravity: 1.03-1.07 at 20°C (liquid)</p> <p>12.8 Liquid Surface Tension: 37 dynes/cm = 0.037 N/m at 20°C</p> <p>12.9 Liquid Water Interfacial Tension: Data not available</p> <p>12.10 Vapor (Gas) Specific Gravity: Not pertinent</p> <p>12.11 Ratio of Specific Heats of Vapor (Gas): 1.073</p> <p>12.12 Latent Heat of Vaporization: (est.) 200 Btu/lb = 110 cal/g = 4.6 X 10⁴ J/kg</p> <p>12.13 Heat of Combustion: -14,720 to -14,740 Btu/lb = -8180 to -8190 cal/g = -342.5 to -342.9 X 10⁴ J/kg</p> <p>12.14 Heat of Decomposition: Not pertinent</p> <p>12.15 Heat of Solution: Not pertinent</p> <p>12.16 Heat of Polymerization: Not pertinent</p> <p>12.25 Heat of Fusion: 26.28 cal/g (p-Cresol)</p> <p>12.26 Limiting Value: Data not available</p> <p>12.27 Reid Vapor Pressure: 0.03 psia</p>																																																
<p style="text-align: center;">8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 24 mg/l/96 hr/bluegill/TL₅₀/fresh water 10-100 ppm/48 hr/shrimp/LC₅₀/salt water</p> <p>8.2 Waterfowl Toxicity: Data not available</p> <p>8.3 Biological Oxygen Demand (BOD): m-cresol: 170%, 5 days o-cresol: 164%, 5 days p-cresol: 144%, 5 days</p> <p>8.4 Food Chain Concentration Potential: None</p>	<p style="text-align: center;">9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: USP Liquid (mixed isomers) Phenol-cresol mixtures Ortho-cresol 80 to 98% containing phenol Meta-cresol 60 to 98% containing other cresols and xylenols Para-cresol 92 to 98% containing meta-cresol Meta-para-cresol containing ortho-cresol and xylenols "Resin" cresols containing phenols and xylenols Cresylic acids containing xylenols, cresols and phenols</p> <p>9.2 Storage Temperature: Ambient</p> <p>9.3 Inert Atmosphere: No requirement</p> <p>9.4 Venting: Open</p>																																																
<p style="text-align: center;">6. FIRE HAZARDS (Continued)</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data not available</p> <p>6.12 Flame Temperature: Data not available</p>																																																	

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 (estimate)	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise (estimate)
35	65.469	46	.490	52	1.048	40	15.050
40	65.349	48	.490	54	1.048	50	12.020
45	65.230	50	.490	56	1.048	60	9.678
50	65.110	52	.490	58	1.048	70	7.858
55	64.990	54	.490	60	1.048	80	6.430
60	64.860	56	.490	62	1.048	90	5.300
65	64.740	58	.490	64	1.048	100	4.399
70	64.620	60	.490	66	1.048	110	3.675
75	64.500	62	.490	68	1.048	120	3.089
80	64.379	64	.490	70	1.048	130	2.612
85	64.259	66	.490	72	1.048	140	2.221
90	64.139	68	.490	74	1.048	150	1.899
95	64.009	70	.490	76	1.048	160	1.632
100	63.890	72	.490	78	1.048	170	1.409
		74	.490	80	1.048	180	1.222
		76	.490	82	1.048	190	1.064
		78	.490	84	1.048	200	.931
		80	.490	86	1.048	210	.818
		82	.490	88	1.048		
		84	.490	90	1.048		
		86	.490	92	1.048		
		88	.490	94	1.048		
		90	.490	96	1.048		
		92	.490	98	1.048		
		94	.490	100	1.048		
		96	.490	102	1.048		

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 (estimate)	Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F
68.02	2.200	40	.004	40	.00008	0	.236
		60	.008	60	.00016	20	.246
		80	.017	80	.00032	40	.257
		100	.034	100	.00060	60	.267
		120	.062	120	.00109	80	.276
		140	.111	140	.00187	100	.286
		160	.192	160	.00312	120	.296
		180	.319	180	.00502	140	.305
		200	.514	200	.00785	160	.314
		220	.805	220	.01193	180	.323
		240	1.230	240	.01771	200	.332
		260	1.835	260	.02568	220	.341
		280	2.679	280	.03648	240	.350
		300	3.834	300	.05084	260	.358
		320	5.387	320	.06960	280	.366
		340	7.442	340	.09374	300	.375
						320	.382
						340	.390
						360	.398
						380	.405
						400	.413
						420	.420
						440	.427

1,1-DICHLOROETHANE

DCH

Common Synonyms Ethylidene chloride Ethylene dichloride Chlorinated hydrocarbon ether		Only liquid	Colorless	Chloroform like ethereal
Sinks and mixes with water.				
Wear goggles, self-contained breathing apparatus and rubber overclothing. Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		Flammable. POISONOUS GAS MAY BE PRODUCED IN FIRE OR WHEN HEATED. Containers may explode in fire. Wear goggles and self-contained breathing apparatus. Extinguish with alcohol foam, carbon dioxide or dry chemical. Water may be ineffective on fire.		
Exposure		CALL FOR MEDICAL AID. LIQUID If swallowed may cause nausea, vomiting and faintness. Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES , hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS have victim drink water or milk and induce vomiting.		
Water Pollution		Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability. Restrict access. Chemical and physical treatment.		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: C ₂ H ₂ Cl 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): Only 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: 656°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		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-Q-R-S	
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		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	
8. WATER POLLUTION 8.1 Aquatic Toxicity: TL ₅₀ (Menne pinperch) 250 to 275 mg/l 24-hour TL ₅₀ Brine shrimp: 320 mg/l 24-hour TL ₅₀ 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		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 98.97 12.3 Boiling Point at 1 atm: 135.14°F = 57.3°C = 330.5°K 12.4 Freezing Point: -143.32°F = -97.4°C = 175.75°K 12.5 Critical Temperature: 502.7°F = 261.5°C = 534.65°K 12.6 Critical Pressure: 734.8 psia = 50 atm = 5.065 MN/m ² 12.7 Specific Gravity: 1.174 at 20°C 12.8 Liquid Surface Tension: 24.75 dynes/cm = 0.02475 N/m at 20°C 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: 3.42 12.11 Ratio of Specific Heats of Vapor (Gas): 1.136 at 20°C (68°F) 12.12 Latent Heat of Vaporization: 131.6 Btu/lb = 73.1 cal/g = 3.06 X 10 ⁴ J/kg 12.13 Heat of Combustion: -4,774 Btu/lb = -2,652 cal/g = -111 X 10 ⁴ J/kg 12.14 Heat of Decomposition: Data not available 12.15 Heat of Solution: Data not available 12.16 Heat of Polymerization: Data not available 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 7.35 psia	
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			
NOTES			

DCH	DICHLOROETHANE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	75.198		D	35	.804	35	.617
40	74.929		A	40	.799	40	.595
45	74.660		T	45	.795	45	.574
50	74.389		A	50	.791	50	.555
55	74.120			55	.786	55	.537
60	73.851		N	60	.782	60	.520
65	73.580		O	65	.778	65	.504
70	73.311		T	70	.773	70	.489
75	73.042			75	.769	75	.475
80	72.771		A	80	.765	80	.462
85	72.502		V	85	.760	85	.449
			A	90	.756	90	.437
			I	95	.752	95	.426
			L	100	.747	100	.415
			A	105	.743	105	.405
			B	110	.739	110	.395
			L			115	.386
			E			120	.377

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	.500	-70	-1.334	-100	.07407		D
		-60	-1.944	-80	.05000		A
		-50	-555	-60	.02594		T
		-40	.835	-40	.00187		A
		-30	.225	-20	.02219		
		-20	.386	0	.04626		N
		-10	.996	20	.07032		O
		0	1.607	40	.09439		T
		10	2.217	60	.11845		
		20	2.827	80	.14252		A
		30	3.438	100	.16658		V
		40	4.048	120	.19065		A
		50	4.658	140	.21471		I
		60	5.269	160	.23878		L
		70	5.879				A
		80	6.489				B
		90	7.100				L
		100	7.710				E
		110	8.321				
		120	8.931				
		130	9.541				

ETHYLBENZENE

ETB

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

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

Fire	<p>FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective or fire. Cool exposed containers with water.</p>
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Exposure	<p>CALL FOR MEDICAL AID.</p> <p>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.</p> <p>LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
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Water Pollution	<p>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.</p>
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<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment</p>	<p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p>
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<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Aromatic hydrocarbon 3.2 Formula: C₈H₁₀CH₃ 3.3 IMO/IUN Designation: 3.3/1175 3.4 DOT ID No.: 1175 3.5 CAS Registry No.: 100-41-4</p>	<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic</p>
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<p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles. 5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters. 5.3 Treatment of Exposure: INHALATION: If ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonia. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 200 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 5 g/kg (rat) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. 5.10 Odor Threshold: 140 ppm 5.11 IDLH Value: 2,000 ppm</p>	
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<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 80°F O.C.; 59°F C.C. 6.2 Flammable Limits in Air: 1.0%-6.7% 6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: irritating vapors are generated when heated. 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back. 6.7 Ignition Temperature: 860°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data Not Available</p>	
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<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>	
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<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>2</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>2</td> </tr> <tr> <td>Poisons</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect</td> <td>2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>1</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>2</td> </tr> <tr> <td>Flammability (Red)</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>		Category	Rating	Fire	3	Health		Vapor Irritant	2	Liquid or Solid Irritant	2	Poisons	2	Water Pollution		Human Toxicity	1	Aquatic Toxicity	3	Aesthetic Effect	2	Reactivity		Other Chemicals	1	Water	0	Self Reaction	0	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	3	Reactivity (Yellow)	0
Category	Rating																																				
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Reactivity (Yellow)	0																																				

<p>7. CHEMICAL REACTIVITY</p> <p>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</p>	
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<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.17 12.3 Boiling Point at 1 atm: 277.2°F = 136.2°C = 409.4°K 12.4 Freezing Point: -139°F = -95°C = 178°K 12.5 Critical Temperature: 651.0°F = 343.9°C = 617.1°K 12.6 Critical Pressure: 523 psia = 35.6 atm = 3.61 MN/m² 12.7 Specific Gravity: 0.867 at 20°C (liquid) 12.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35 X 10⁴ J/kg 12.13 Heat of Combustion: -17,780 Btu/lb = -8677 cal/g = -413.5 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data Not Available 12.26 Limiting Value: Data Not Available 12.27 Reid Vapor Pressure: 0.4 psia</p>	
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<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 29 ppm/96 hr/bluegill/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 2.2% (theor.), 5 days 8.4 Food Chain Concentration Potential: None</p>	
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<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>	
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<p>6. FIRE HAZARDS (Continued)</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data Not Available 6.12 Flame Temperature: Data Not Available</p>	
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ETB

ETHYLBENZENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
40	54.990	40	.402	-90	1.065	40	.835
50	54.680	50	.404	-80	1.056	50	.774
60	54.370	60	.407	-70	1.047	60	.719
70	54.060	70	.409	-60	1.037	70	.670
80	53.750	80	.412	-50	1.028	80	.626
90	53.430	90	.414	-40	1.018	90	.586
100	53.120	100	.417	-30	1.009	100	.550
110	52.810	110	.419	-20	1.000	110	.518
120	52.500	120	.421	-10	.990	120	.488
130	52.190	130	.424	0	.981	130	.461
140	51.870	140	.426	10	.971	140	.436
150	51.560	150	.429	20	.962	150	.414
160	51.250	160	.431	30	.953	160	.393
170	50.940	170	.434	40	.943	170	.374
180	50.620	180	.436	50	.934	180	.356
190	50.310	190	.439	60	.924	190	.340
200	50.000	200	.441	70	.915	200	.325
210	49.690	210	.443	80	.906	210	.311
				90	.896		
				100	.887		
				110	.877		
				120	.868		
				130	.859		
				140	.849		
				150	.840		
				160	.830		

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	.020	80	.202	80	.00370	-400	-.007
		100	.370	100	.00654	-350	.026
		120	.644	120	.01099	-300	.060
		140	1.071	140	.01767	-250	.093
		160	1.713	160	.02734	-200	.125
		180	2.643	180	.04087	-150	.157
		200	3.953	200	.05926	-100	.187
		220	5.747	220	.08363	-50	.217
		240	8.147	240	.11520	0	.246
		260	11.290	260	.15510	50	.274
		280	15.320	280	.20490	100	.301
		300	20.410	300	.26570	150	.327
		320	26.730	320	.33910	200	.353
		340	34.460	340	.42620	250	.377
		360	43.800	360	.52850	300	.401
		380	54.950	380	.64720	350	.424
						400	.446
						450	.467
						500	.487
						550	.507
						600	.525

METHYL CHLORIDE

MTC

Common Synonyms Chloromethane Arc		Gas	Colorless	Odorless or sweet odor
Avoid contact with liquid and vapor. Keep people away. Wear goggles and self-contained breathing apparatus. Stop discharge if possible. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire		<p>FLAMMABLE POISONOUS GASES ARE PRODUCED IN FIRE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Stop discharge if possible. Cool exposed containers and protect men effecting shutoff with water. Let fire burn.</p>		
Exposure		<p>CALL FOR MEDICAL AID. VAPOR Not irritating to eyes, nose or throat. If inhaled, will cause nausea, vomiting, 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 Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS.</p>		
Water Pollution		Not harmful to aquatic life.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability, air contaminant Restrict access Evacuate area		2. LABEL 2.1 Category: Flammable gas 2.2 Class: 2		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: CH ₃ Cl 3.3 IMO/UN Designation: 2.0/1063 3.4 DOT ID No.: 1063 3.5 CAS Registry No.: 74-87-3		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquefied gas 4.2 Color: Colorless 4.3 Odor: Faint, sweet, non-irritating; tart ether-like		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Approved canister mask; leather or vinyl gloves; goggles or face shield. 5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, headache, emotional disturbances; high concentrations cause mental confusion, eye disturbances, muscular tremors, cyanosis, convulsions. Contact of liquid with skin may cause frostbite. 5.3 Treatment of Exposure: Remove to fresh air. Call a doctor and have patient hospitalized for observation of slowly developing symptoms. 5.4 Threshold Limit Value: 50 ppm 5.5 Short Term Inhalation Limit: 100 ppm for 5 min. 5.6 Toxicity by Ingestion: Not pertinent 5.7 Late Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to the eyes and throat. 5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard. Practically harmless to the skin because it evaporates quickly. May cause frostbite. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 10,000 ppm				

6. FIRE HAZARDS 6.1 Flash Point: <32°F C.C. 6.2 Flammable Limits in Air: 8.1%-17.2% 6.3 Fire Extinguishing Agents: Dry chemical or carbon dioxide. Stop flow of gas. 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: 1170°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 2.2 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: 4.076 (Est.) 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-B-C-D-E-F-G																																					
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Reacts with zinc, aluminum, magnesium, and their alloys; reaction is not violent. 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 36		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable gas 11.2 NFPA Hazard Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td>4</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant.....</td> <td>0</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td>0</td> </tr> <tr> <td>Poisons.....</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity.....</td> <td>0</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td>1</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td>0</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals.....</td> <td>1</td> </tr> <tr> <td>Water.....</td> <td>0</td> </tr> <tr> <td>Salt Reaction.....</td> <td>0</td> </tr> </tbody> </table> 11.3 NFPA Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td>2</td> </tr> <tr> <td>Flammability (Red).....</td> <td>4</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td>0</td> </tr> </tbody> </table>		Category	Rating	Fire.....	4	Health		Vapor Irritant.....	0	Liquid or Solid Irritant.....	0	Poisons.....	2	Water Pollution		Human Toxicity.....	0	Aquatic Toxicity.....	1	Aesthetic Effect.....	0	Reactivity		Other Chemicals.....	1	Water.....	0	Salt Reaction.....	0	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	4	Reactivity (Yellow).....	0
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8. WATER POLLUTION 8.1 Aquatic Toxicity: None 8.2 Waterflow Toxicity: None 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Gas 12.2 Molecular Weight: 50.48 12.3 Boiling Point at 1 atm: -11.6°F = -24.2°C = 249°K 12.4 Freezing Point: -143.8°F = 87.7°C = 175.5°K 12.5 Critical Temperature: 290.5°F = 143.6°C = 416.8°K 12.6 Critical Pressure: 968 psia = 65.8 atm = 6.68 MN/m ² 12.7 Specific Gravity: 0.997 at -24°C (liquid) 12.8 Liquid Surface Tension: 16.2 dynes/cm = 0.0162 N/m at 20°C 12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at -24°C 12.10 Vapor (Gas) Specific Gravity: 1.7 12.11 Ratio of Specific Heats of Vapor (Gas): 1.259 12.12 Latent Heat of Vaporization: 182.3 Btu/lb = 101.3 cal/g = 4,241 X 10 ³ J/kg 12.13 Heat of Combustion: -5290 Btu/lb = -2939 cal/g = -123.1 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 116.7 psia																																					
9. SHIPPING INFORMATION 9.1 Grades of Purity: Technical grade; "Arc" refrigerant grade 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Safety relief		NOTES																																					

MTC

METHYL 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
-20	62.170	-50	.354		D A T A N O T A V A I L A B L E	-30	.332
-15	61.860	-40	.357			-20	.320
		-30	.359				
		-20	.362				

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	-55	4.590	-55	.05335	0	.177
		-50	5.298	-50	.06083	25	.182
		-45	6.095	-45	.06913	50	.187
		-40	6.987	-40	.07831	75	.192
		-35	7.985	-35	.08843	100	.197
		-30	9.096	-30	.09957	125	.202
		-25	10.330	-25	.11180	150	.207
		-20	11.700	-20	.12520	175	.212
		-15	13.210	-15	.13980	200	.217
		-10	14.880	-10	.15570	225	.221
		-5	16.720	-5	.17300	250	.226
		0	18.730	0	.19170	275	.231
		5	20.940	5	.21200	300	.236
		10	23.350	10	.23390	325	.240
		15	25.980	15	.25740	350	.245
		20	28.840	20	.28280	375	.249
		25	31.950	25	.31000	400	.254
		30	35.320	30	.33920	425	.258
		35	38.960	35	.37040	450	.263
		40	42.890	40	.40380	475	.267
		45	47.140	45	.43930	500	.272
		50	51.700	50	.47720	525	.276
		55	56.610	55	.51740	550	.281
		60	61.880	60	.56000	575	.285
		65	67.520	65	.60530	600	.289

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	<p>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 or fire. Cool exposed containers with water.</p>		
Exposure	<p>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.</p>		
Water Pollution	<p>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.</p>		
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: $C_4H_{10}O$ 3.3 IMO/UN Designation: 3.2/1193 3.4 DOT ID No.: 1193 3.5 CAS Registry No.: 76-93-3		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 Limit: 290 mg/m ³ 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: 16
8. WATER POLLUTION	
8.1 Aquatic Toxicity: 5640 mg/l/48 hr/bluegill/TL ₅₀ /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 Classification:	
Category	Classification
Health Hazard (Blue).....	1
Flammability (Red).....	3
Reactivity (Yellow).....	0
12. PHYSICAL AND CHEMICAL PROPERTIES	
12.1 Physical State at 15°C and 1 atm: Liquid	12.2 Molecular Weight: 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 = 535.7°K	12.6 Critical Pressure: 603 psia = 41.0 atm = 4.15 MN/m ²
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 10 ⁴ J/kg
12.13 Heat of Combustion: -13,480 Btu/lb = -7491 cal/g = -313.6 X 10 ⁴ J/kg	12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution (est): -9 Btu/lb = -5 cal/g = -0.2 X 10 ⁴ 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		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	51.460	-35	.501	10	1.073		N O T P E R T I N E N T
40	51.280	-30	.502	15	1.068		
45	51.110	-25	.503	20	1.063		
50	50.940	-20	.504	25	1.058		
55	50.760	-15	.505	30	1.053		
60	50.590	-10	.507	35	1.048		
65	50.420	-5	.508	40	1.043		
70	50.240	0	.509	45	1.038		
75	50.070	5	.510	50	1.033		
80	49.900	10	.511	55	1.028		
85	49.720	15	.512	60	1.023		
90	49.550	20	.513	65	1.018		
95	49.380	25	.514	70	1.013		
100	49.200	30	.516	75	1.008		
105	49.030	35	.517	80	1.003		
110	48.860	40	.518	85	.998		
115	48.680	45	.519	90	.993		
120	48.510	50	.520	95	.988		
		55	.521	100	.983		
		60	.522	105	.978		
		65	.523				
		70	.524				
		75	.526				
		80	.527				
		85	.528				
		90	.529				

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	27.000	0	.148	0	.00216	0	.352
		10	.216	10	.00310	25	.368
		20	.310	20	.00435	50	.384
		30	.437	30	.00599	75	.399
		40	.604	40	.00812	100	.414
		50	.823	50	.01085	125	.429
		60	1.104	60	.01427	150	.444
		70	1.461	70	.01853	175	.458
		80	1.909	80	.02376	200	.472
		90	2.465	90	.03012	225	.486
		100	3.147	100	.03778	250	.500
		110	3.977	110	.04690	275	.513
		120	4.977	120	.05768	300	.526
		130	6.171	130	.07030	325	.538
		140	7.586	140	.08498	350	.551
		150	9.250	150	.10190	375	.563
		160	11.190	160	.12130	400	.575
		170	13.450	170	.14350	425	.586
		180	16.050	180	.16850	450	.598
		190	19.030	190	.19670	475	.609
		200	22.420	200	.22830	500	.620
		210	26.270	210	.26350	525	.630
		220	30.610	220	.30250	550	.640
		230	35.480	230	.34560	575	.650
		240	40.930	240	.39290	600	.660

NAPHTHALENE

NTM

Common Synonyms Naphthalin Tar camphor	Solid Solidifies and floats or sinks in water.	Colorless	Mothballs odor
Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and solid. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Combustible. Wear goggles and self-contained breathing apparatus. Extinguish with water, foam, dry chemical or carbon dioxide. Cool exposed containers with water.		
Exposure	CALL FOR MEDICAL AID SOLID OR LIQUID Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.		
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) 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: Aromatic Hydrocarbon 3.2 Formula: C ₁₀ H ₈ 3.3 IMO/UN Designation: 4.1/2304 3.4 DOT ID No.: 2304 3.5 CAS Registry No.: 91-20-3	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Molten solid 4.2 Color: Colorless 4.3 Odor: Coal tar, moth balls		
5. HEALTH HAZARDS			
5.1 Personal Protective Equipment: Approved organic vapor canister unit; rubber gloves; chemical safety goggles; face shield; coveralls and/or rubber apron; rubber shoes or boots. 5.2 Symptoms Following Exposure: Vapors or fumes are irritating to eyes, nose, and throat and may cause headaches, dizziness, nausea, etc. Solid may be irritating to skin. 5.3 Treatment of Exposure: INHALATION: remove to fresh air. SKIN OR EYES: flush immediately with plenty of water for at least 15 min.; remove contaminated clothing immediately; call a physician. 5.4 Threshold Limit Value: 10 ppm 5.5 Short Term Inhalation Limit: 15 ppm for 5 min. 5.6 Toxicity by Ingestion: Grade 2; oral rat LD ₅₀ = 1780 mg/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Hot liquid can cause severe burn. The solid may irritate the skin. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 500 ppm			

6. FIRE HAZARDS 6.1 Flash Point: 174°F C.C.; 190°F O.C. 6.2 Flammable Limits in Air: 0.9%-5.9% 6.3 Fire Extinguishing Agents: Water fog, carbon dioxide, dry chemical, or foam 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Toxic vapors given off in a fire. 6.6 Behavior In Fire: Not pertinent 6.7 Ignition Temperature: 979°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4.3 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-X 11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-A 11.2 NAS Hazard Rating for Bulk Water Transportation: <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td>1</td> </tr> <tr> <td>Health.....</td> <td>2</td> </tr> <tr> <td>Vapor Irritant.....</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td>2</td> </tr> <tr> <td>Poisons.....</td> <td>2</td> </tr> <tr> <td>Water Pollution.....</td> <td></td> </tr> <tr> <td>Human Toxicity.....</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td>3</td> </tr> <tr> <td>Reactivity.....</td> <td></td> </tr> <tr> <td>Other Chemicals.....</td> <td>1</td> </tr> <tr> <td>Water.....</td> <td>0</td> </tr> <tr> <td>Self Reaction.....</td> <td>0</td> </tr> </tbody> </table> 11.3 NFPA Hazard Classification: <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td>2</td> </tr> <tr> <td>Flammability (Red).....</td> <td>2</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td>0</td> </tr> </tbody> </table>	Category	Rating	Fire.....	1	Health.....	2	Vapor Irritant.....	1	Liquid or Solid Irritant.....	2	Poisons.....	2	Water Pollution.....		Human Toxicity.....	1	Aquatic Toxicity.....	3	Aesthetic Effect.....	3	Reactivity.....		Other Chemicals.....	1	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	2	Reactivity (Yellow).....	0
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7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: Molten naphthalene splatters and foams in contact with water. No chemical reaction is involved. 7.2 Reactivity with Common Materials: None 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	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 126.18 12.3 Boiling Point at 1 atm: 424°F = 218°C = 491°K 12.4 Freezing Point: 176.4°F = 80.2°C = 353.4°K 12.5 Critical Temperature: 887.4°F = 475.2°C = 748.4°K 12.6 Critical Pressure: 586 psia = 40.0 atm = 4.05 MN/m ² 12.7 Specific Gravity: 1.145 at 20°C (solid) 12.8 Liquid Surface Tension: 31.8 dynes/cm = 0.0318 N/m at 100°C 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.068 12.12 Latent Heat of Vaporization: 145 Btu/lb = 80.7 cal/g = 3.38 X 10 ⁴ J/kg 12.13 Heat of Combustion: -16,720 Btu/lb = -9287 cal/g = -388.8 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 35.06 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Low																																				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 150 mg/l/96 hr/sunfish/TL ₅₀ /fresh water 1.8 ppm/72 hr/fingerling salmon/critical/ salt water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): (theor.) 58.5%, 6 days 8.4 Food Chain Concentration Potential: None	9. SHIPPING INFORMATION 9.1 Grades of Purity: Pure; crude: 95% Pure; mp = 176°F Crude; mp = 165-176°F 9.2 Storage Temperature: Elevated 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum																																				
NOTES																																					

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot (estimate)	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F (estimate)	Temperature (degrees F)	Centipoise
177	69.290	180	.382	177	.901	180	.837
178	69.290	200	.391	178	.901	185	.784
179	69.290	220	.401	179	.901	190	.735
180	69.290	240	.410	180	.901	195	.690
181	69.290	260	.419	181	.901	200	.648
182	69.290	280	.429	182	.901	205	.609
183	69.290	300	.438	183	.901	210	.573
184	69.290	320	.447	184	.901	215	.540
185	69.290	340	.457	185	.901	220	.509
186	69.290	360	.466	186	.901	225	.480
187	69.290	380	.475	187	.901	230	.454
188	69.290	400	.485	188	.901	235	.429
189	69.290	420	.494	189	.901	240	.406
190	69.290			190	.901	245	.384
191	69.290			191	.901	250	.364
192	69.290			192	.901	255	.345
193	69.290			193	.901	260	.327
						265	.311
						270	.295
						275	.281
						280	.267
						285	.254
						290	.242
						295	.231
						300	.221
						305	.210

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	.300	180	.148	180	.00276	0	.207
		200	.254	200	.00460	25	.220
		220	.420	220	.00739	50	.233
		240	.670	240	.01143	75	.246
		260	1.032	260	.01713	100	.259
		280	1.544	280	.02493	125	.271
		300	2.250	300	.03537	150	.283
		320	3.200	320	.04901	175	.295
		340	4.453	340	.06650	200	.307
		360	6.075	360	.08850	225	.318
		380	8.138	380	.11570	250	.330
		400	10.720	400	.14890	275	.340
		420	13.910	420	.18890	300	.351
		440	17.810	440	.23630	325	.362
		460	22.490	460	.29210	350	.372
		480	28.080	480	.35680	375	.382
						400	.391
						425	.401
						450	.410
						475	.419
						500	.428
						525	.436
						550	.445
						575	.453
						600	.460

<p>Common Synonyms</p> <p>Hydroxybenzene Carboic acid Phenic acid Phenyl hydroxide</p>	<p>Solid crystals, or watery liquid</p> <p>White solid or light pink liquid</p> <p>Sweet tarry odor</p>	<p>May float or sink, and moves slowly with water.</p>
<p>AVOID CONTACT WITH LIQUID AND SOLID. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Stop discharge if possible. Call fire department. Evacuate area in case of large discharge. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
Fire	<p>Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with water, carbon dioxide, dry chemical, or foam. Cool exposed containers with water.</p>	
Exposure	<p>CALL FOR MEDICAL AID. LIQUID OR SOLID POISONOUS IF SWALLOWED. Will burn skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>	
Water Pollution	<p>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.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook)</p> <p>Issue warning-poison Restrict access Should be removed Chemical and physical treatment</p>	<p>2. LABEL</p> <p>2.1 Category: Poison 2.2 Class: 6</p>	
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Phenol, cresol 3.2 Formula: C₆H₅OH 3.3 IMD/UN Designation: 9.0/1671 3.4 DOT ID No.: 1671 3.5 CAS Registry No.: 106-95-2</p>	<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Solid or molten liquid 4.2 Color: Colorless to light pink 4.3 Odor: Characteristically sweet; sweet, tarry, pungent, distinctive; distinct, aromatic, somewhat sickening sweet and acid</p>	
<p style="text-align: center;">5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Fresh-air mask for confined areas; rubber gloves; protective clothing; full face shield.</p> <p>5.2 Symptoms Following Exposure: Will burn eyes and skin. The analgesic action may cause loss of pain sensation. Readily absorbed through skin, causing increase in heart rate, convulsions, and death.</p> <p>5.3 Treatment of Exposure: INHALATION: If victim shows any ill effects, move him to fresh air, keep him quiet and warm, and call a doctor immediately; if breathing stops, give artificial respiration. INGESTION: do NOT induce vomiting; give milk, egg whites, or large amounts of water and call doctor immediately; no known antidote; treat the symptoms. EYES: immediately flush with plenty of water for at least 15 min.; continue for another 15 min. if doctor has not taken over. SKIN: immediately remove all clothing while in a shower and wash affected area with abundant flowing water or soap and water for at least 15 min.; clean clothing thoroughly or discard.</p> <p>5.4 Threshold Limit Value: 5 ppm (includes skin exposure).</p> <p>5.5 Short Term Inhalation Limits: Data not available</p> <p>5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 5 g/kg (rat)</p> <p>5.7 Late Toxicity: Carcinogenic in laboratory animals</p> <p>5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.</p> <p>5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant; may cause pain and second-degree burns after a few minutes' contact.</p> <p>5.10 Odor Threshold: 0.05 ppm</p> <p>5.11 IDLH Value: 100 ppm</p>		

<p style="text-align: center;">6. FIRE HAZARDS</p> <p>6.1 Flash Point: 185°F O.C.; 175°F C.C. 6.2 Flammable Limits in Air: 1.7%-8.6% 6.3 Fire Extinguishing Agents: Water fog, foam, carbon dioxide, or dry chemical 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Toxic and irritating vapors are generated when heated. 6.6 Behavior in Fire: Yields flammable vapors when heated which will form explosive mixtures with air. 6.7 Ignition Temperature: 1319°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 3.5 mm/min. 6.10 Adiabatic Flame Temperature: Data not available</p> <p style="text-align: right;"><i>(Continued)</i></p>	<p style="text-align: center;">10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-Q</p>																																				
<p style="text-align: center;">7. CHEMICAL REACTIVITY</p> <p>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 Polymerizators: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 21</p>	<p style="text-align: center;">11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Poison, B 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td>1</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant.....</td> <td>2</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td>3</td> </tr> <tr> <td>Poisons.....</td> <td>3</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity.....</td> <td>2</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td>3</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals.....</td> <td>2</td> </tr> <tr> <td>Water.....</td> <td>0</td> </tr> <tr> <td>Self Reaction.....</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td>3</td> </tr> <tr> <td>Flammability (Red).....</td> <td>2</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td>0</td> </tr> </tbody> </table>	Category	Rating	Fire.....	1	Health		Vapor Irritant.....	2	Liquid or Solid Irritant.....	3	Poisons.....	3	Water Pollution		Human Toxicity.....	2	Aquatic Toxicity.....	3	Aesthetic Effect.....	3	Reactivity		Other Chemicals.....	2	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	3	Flammability (Red).....	2	Reactivity (Yellow).....	0
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Reactivity (Yellow).....	0																																				
<p style="text-align: center;">8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 11.5-26.5 mg/l/96 hr/bluegill/TL₅₀/fresh water 1.5 ppn/48 hr/rainbow trout/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 200%, 5 days 8.4 Food Chain Concentration Potential: None</p>	<p style="text-align: center;">12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Solid or liquid 12.2 Molecular Weight: 94.11 12.3 Boiling Point at 1 atm: 359.2°F = 181.8°C = 455.0°K 12.4 Freezing Point: 105.6°F = 40.9°C = 314.1°K 12.5 Critical Temperature: 790.0°F = 421.1°C = 694.2°K 12.6 Critical Pressure: 889 psia = 60.5 atm = 6.13 MN/m² 12.7 Specific Gravity: 1.058 at 41°C (liquid) 12.8 Liquid Surface Tension: 36.5 dynes/cm = 0.0365 N/m at 55°C 12.9 Liquid Water Interfacial Tension: (est.) 20 dynes/cm = 0.02 N/m at 42°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.069 12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0 X 10³ J/kg 12.13 Heat of Combustion: -13,400 Btu/lb = -7,445 cal/g = -311.7 X 10³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.3 psia</p>																																				
<p style="text-align: center;">9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: 90-99% (solid), 80-85% (liquid). Technical: 82-82% (contains cresols) 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum</p>	<p style="text-align: center;">6. FIRE HAZARDS (Continued)</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>																																				

PHN	PHENOL
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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 (estimate)	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
110	65.870	108	.561	122.02	1.113	110	4.302
115	65.719	109	.561			115	3.929
120	65.559	110	.561			120	3.594
125	65.410	111	.561			125	3.292
130	65.250	112	.561			130	3.021
135	65.099	113	.561			135	2.775
140	64.940	114	.561			140	2.554
145	64.790	115	.561			145	2.353
150	64.629	116	.561			150	2.171
155	64.469	117	.561			155	2.005
160	64.309	118	.561			160	1.855
165	64.160	119	.561			165	1.718
170	64.000	120	.561			170	1.593
175	63.840	121	.561			175	1.479
180	63.670	122	.561				
185	63.510	123	.561				
190	63.350	124	.561				
195	63.190	125	.561				
200	63.020	126	.561				
205	62.860	127	.561				
210	62.690	128	.561				
		129	.561				
		130	.561				
		131	.561				
		132	.561				
		133	.561				

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	8.400	70	.012	70	.00019	0	.224
		80	.017	80	.00027	25	.237
		90	.024	90	.00039	50	.250
		100	.034	100	.00054	75	.262
		110	.048	110	.00074	100	.274
		120	.066	120	.00100	125	.286
		130	.091	130	.00135	150	.297
		140	.123	140	.00180	175	.309
		150	.165	150	.00238	200	.319
		160	.220	160	.00311	225	.330
		170	.289	170	.00403	250	.341
		180	.378	180	.00518	275	.351
		190	.490	190	.00661	300	.360
		200	.629	200	.00836	325	.370
		210	.802	210	.01050	350	.379
		220	1.016	220	.01311	375	.388
		230	1.278	230	.01624	400	.397
		240	1.596	240	.02000	425	.405
		250	1.982	250	.02449	450	.414
		260	2.446	260	.02980	475	.422
		270	3.002	270	.03607	500	.429
		280	3.663	280	.04342	525	.436
		290	4.446	290	.05200	550	.444
		300	5.370	300	.06197	575	.450
		310	6.453	310	.07350	600	.457
		320	7.718	320	.08679		

TETRACHLOROETHANE

TEC

<p>Common Synonyms 1, 1, 2, 2-Tetrachloroethane Acetylene tetrachloride</p>	<p>Liquid Colorless to pale yellow Sweet odor</p>
<p>Sinks in water.</p>	
<p>AVOID CONTACT WITH LIQUID AND VAPOR. KEEP PEOPLE AWAY. Wear rubber overboots (including gloves). Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<p>Fire</p>	<p>Not flammable. Poisonous gases may be produced when heated.</p>
<p>Exposure</p>	<p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. Harmful if inhaled. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED. Irritating to skin and eyes. If swallowed will cause nausea and vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>
<p>Water Pollution</p>	<p>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.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-poison, air contaminant Restrict access Should be removed Chemical and physical treatment</p>	<p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: $C_2H_2Cl_4$ 3.3 IMO/IUN Designation: Not listed 3.4 DOT ID No.: 1702 3.5 CAS Registry No.: 1299-90-7</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless yellowish green 4.3 Odor: Chloroform-like, pleasant like carbon tetrachloride; mild, sweetish, similar to several other chlorinated hydrocarbons.</p>
<p>5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Chemical safety goggles; plastic face shield; air- or oxygen-supplied mastic safety hat with brim; solvent-proof apron; synthetic rubber gloves 5.2 Symptoms Following Exposure: Compound is a powerful narcotic and liver poison; may also cause changes in blood composition and neurological disturbances. Repeated exposure by inhalation can be fatal. Ingestion causes vomiting, diarrhea, severe mucosal injury, liver necrosis, cyanosis, unconsciousness, loss of reflexes, and death. Contact with eyes causes irritation and lachrymation. Can be absorbed through the skin and may produce severe skin lesions. 5.3 Treatment of Exposure: INHALATION: remove victim from exposure; begin artificial respiration if breathing has ceased. INGESTION: induce vomiting; call a physician. EYES: irrigate with water for 15 min. SKIN: remove clothing; wash skin thoroughly with warm water and soap. 5.4 Threshold Limit Value: 1 ppm 5.5 Short Term Inhalation Limit: 10 ppm, 30 min. 5.6 Toxicity by Ingestion: Grade 3; oral $LD_{50} = 200$ mg/kg (rat) 5.7 Late Toxicity: Liver poisoning, nervous disorders 5.8 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 0.5 ppm 5.11 IDLH Value: 150 ppm</p>	

<p>6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Irritating hydrogen chloride vapor may form in fire. 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X</p>
<p>7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: May attack some forms of plastics 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 36</p>	<p>11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-A 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed</p>
<p>8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterway Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: Data not available</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 167.85 12.3 Boiling Point at 1 atm: 295.3°F = 146.3°C = 419.5°K 12.4 Freezing Point: -46.8°F = -43.8°C = 229.4°K 12.5 Critical Temperature: Data not available 12.6 Critical Pressure: Data not available 12.7 Specific Gravity: 1.595 at 20°C (liquid) 12.8 Liquid Surface Tension: 37.85 dynes/cm = 0.03785 N/m at 20°C 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: 5.79 12.11 Ratio of Specific Heats of Vapor (Gas): 1.090 at 25°C 12.12 Latent Heat of Vaporization: 99.2 Btu/lb = 55.1 cal/g = 2.30×10^4 J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.16 Heat of Solution: Not pertinent 12.18 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.5 psia</p>
<p>9. SHIPPING INFORMATION 9.1 Grade of Purity: Technical, 98% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open</p>	<p>NOTES</p>

TEC	TETRACHLOROETHANE
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit: per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
34	101.400	52	.210	30	.791	34	2.527
36	101.299	54	.210	40	.784	36	2.473
38	101.200	56	.210	50	.777	38	2.422
40	101.099	58	.210	60	.770	40	2.371
42	101.000	60	.210	70	.763	42	2.322
44	100.900	62	.210	80	.756	44	2.275
46	100.799	64	.210	90	.748	46	2.229
48	100.599	66	.210	100	.741	48	2.184
50	100.500	68	.210	110	.734	50	2.140
52	100.400	70	.210	120	.727	52	2.098
54	100.299	72	.210	130	.720	54	2.057
56	100.200	74	.210	140	.713	56	2.017
58	100.099	76	.210	150	.706	58	1.977
60	100.000	78	.210	160	.699	60	1.939
62	99.910	80	.210	170	.692	62	1.902
64	99.799	82	.210	180	.685	64	1.866
66	99.690	84	.210	190	.678	66	1.831
68	99.589	86	.210	200	.671	68	1.797
70	99.480					70	1.764
72	99.379					72	1.732
74	99.270					74	1.700
76	99.160					76	1.669
78	99.059					78	1.639
80	98.950					80	1.610
82	98.849					82	1.582
84	98.740					84	1.554

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	.251	80	.161	80	.00468	90	.145
36	.252	90	.216	90	.00614	100	.146
38	.254	100	.285	100	.00797	110	.148
40	.256	110	.374	110	.01026	120	.149
42	.258	120	.485	120	.01309	130	.150
44	.259	130	.624	130	.01655	140	.151
46	.261	140	.796	140	.02076	150	.153
48	.263	150	1.008	150	.02584	160	.154
50	.265	160	1.265	160	.03193	170	.155
52	.266	170	1.578	170	.03918	180	.156
54	.268	180	1.954	180	.04776	190	.157
56	.270	190	2.403	190	.05784	200	.159
58	.272	200	2.938	200	.06964	210	.160
60	.273	210	3.570	210	.08335	220	.161
62	.275	220	4.313	220	.09922	230	.162
64	.277	230	5.182	230	.11750	240	.164
66	.279	240	6.194	240	.13840	250	.165
68	.280	250	7.366	250	.16230	260	.166
70	.282	260	8.719	260	.18940		
72	.284	270	10.270	270	.22010		
74	.286	280	12.050	280	.25470		
76	.287	290	14.070	290	.29350		
78	.289						
80	.291						
82	.293						
84	.294						

TETRACHLOROETHYLENE

TTE

<p>Common Synonyms</p> <p>Tetracap Perdrene Perchloroethylene Perk</p>		<p>Watery liquid</p> <p>Colorless</p> <p>Sweet odor</p>
<p>Sinks in water. Irritating vapor is produced.</p>		
<p>Stop discharge if possible. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
<p>Fire</p>	<p>Not flammable. Poisonous gases are produced when heated.</p>	
<p>Exposure</p>	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. If inhaled, will cause difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>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.</p>	
<p>Water Pollution</p>	<p>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.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment</p>		<p>2. LABEL</p> <p>2.1 Category: None 2.2 Class: Not pertinent</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Not listed 3.2 Formula: C₂Cl₄ 3.3 IMO/UN Designation: 9.0/1897 3.4 DOT ID No.: 1897 3.5 CAS Registry No.: 127-18-4</p>		<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Ethereal; like chloroform, mildly sweet</p>
<p>5. HEALTH HAZARDS</p> <p>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 Limit: 100 ppm for 60 min. 5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 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</p>		

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
Salt 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:
-6.3°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 X 10⁴ 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

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TETRACHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	103.400	0	.198		N	55	.958
40	103.099	10	.200		O	60	.929
45	102.900	20	.201		T	65	.900
50	102.599	30	.202			70	.873
55	102.299	40	.203		P	75	.848
60	102.000	50	.204		E	80	.823
65	101.700	60	.205		R	85	.800
70	101.400	70	.206		T	90	.777
75	101.099	80	.207		I	95	.756
80	100.799	90	.208		N	100	.736
85	100.500	100	.210		E	105	.716
90	100.200	110	.211		N	110	.698
95	99.910	120	.212		T	115	.680
100	99.610	130	.213			120	.663
105	99.320	140	.214			125	.647
110	99.020	150	.215			130	.631
115	98.730	160	.216			135	.616
120	98.429	170	.217			140	.601
125	98.139	180	.218			145	.588
130	97.839	190	.220			150	.574
135	97.549	200	.221			155	.561
140	97.250	210	.222			160	.549
145	96.959					165	.537
150	96.669					170	.526
155	96.370					175	.515
160	96.080						

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	.016	60	.236	60	.00702	0	.108
		70	.318	70	.00929	25	.110
		80	.425	80	.01216	50	.113
		90	.561	90	.01575	75	.116
		100	.732	100	.02022	100	.118
		110	.948	110	.02571	125	.120
		120	1.217	120	.03242	150	.122
		130	1.548	130	.04055	175	.125
		140	1.953	140	.05032	200	.127
		150	2.446	150	.06199	225	.129
		160	3.042	160	.07583	250	.131
		170	3.756	170	.09215	275	.132
		180	4.607	180	.11130	300	.134
		190	5.616	190	.13360	325	.136
		200	6.805	200	.15940	350	.138
		210	8.199	210	.18910	375	.139
		220	9.824	220	.22330	400	.141
		230	11.710	230	.26230	425	.142
		240	13.890	240	.30660	450	.143
		250	16.390	250	.35680	475	.144
		260	19.260	260	.41330	500	.146
		270	22.520	270	.47680	525	.147
		280	26.230	280	.54790	550	.148
						575	.148
						600	.149

TOL

TOLUENE

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
-30	57.180	0	.396	0	1.026	0	1.024
-20	56.870	5	.397	10	1.015	5	.978
-10	56.550	10	.399	20	1.005	10	.935
0	56.240	15	.400	30	.994	15	.894
10	55.930	20	.402	40	.983	20	.857
20	55.620	25	.403	50	.972	25	.821
30	55.310	30	.404	60	.962	30	.788
40	54.990	35	.406	70	.951	35	.757
50	54.680	40	.407	80	.940	40	.727
60	54.370	45	.409	90	.929	45	.700
70	54.060	50	.410	100	.919	50	.673
80	53.750	55	.411	110	.908	55	.649
90	53.430	60	.413	120	.897	60	.625
100	53.120	65	.414	130	.886	65	.603
110	52.810	70	.415	140	.876	70	.582
120	52.500	75	.417	150	.865	75	.562
		80	.418	160	.854	80	.544
		85	.420	170	.843	85	.526
		90	.421	180	.833	90	.509
		95	.422	190	.822	95	.493
		100	.424	200	.811	100	.477
		105	.425	210	.800		
		110	.427				
		115	.428				
		120	.429				
		125	.431				

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	.050	0	.038	0	.00070	0	.228
		10	.057	10	.00103	25	.241
		20	.084	20	.00150	50	.255
		30	.121	30	.00212	75	.268
		40	.172	40	.00296	100	.281
		50	.241	50	.00405	125	.294
		60	.331	60	.00547	150	.306
		70	.449	70	.00727	175	.319
		80	.600	80	.00954	200	.331
		90	.792	90	.01237	225	.343
		100	1.033	100	.01584	250	.355
		110	1.332	110	.02007	275	.367
		120	1.700	120	.02518	300	.378
		130	2.148	130	.03127	325	.389
		140	2.690	140	.03850	350	.400
		150	3.338	150	.04700	375	.411
		160	4.109	160	.05691	400	.422
		170	5.018	170	.06840	425	.432
		180	6.083	180	.08162	450	.443
		190	7.323	190	.09675	475	.453
		200	8.758	200	.11400	500	.462
		210	10.410	210	.13340	525	.472
						550	.482
						575	.491
						600	.500

TOLUENE

TOL

<p>Common Synonyms</p> <p>Toluol Methylbenzene Methylbenzol</p>		<p>Watery liquid</p> <p>Colorless</p> <p>Pleasant odor</p>
<p>Floats on water. Flammable, irritating vapor is produced.</p>		
<p>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.</p>		
<p>Fire</p>		<p>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.</p>
<p>Exposure</p>		<p>CALL FOR MEDICAL AID.</p> <p>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.</p> <p>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.</p>
<p>Water Pollution</p>		<p>Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and welfare officials. Notify operators of nearby water intakes.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area</p>		<p>2. LABEL</p> <p>2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C₇H₈ 3.3 IMO/UN Designation: 3.2/1294 3.4 DOT ID No.: 1294 3.5 CAS Registry No.: 108-88-3</p>		<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Pungent, aromatic, benzene-like; distinct, pleasant</p>
<p>5. HEALTH HAZARDS</p> <p>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; LD₅₀ = 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</p>		

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: 987°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/TL₅₀/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0%, 5 days; 38% (theor), 8 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research, reagent, nitrogen-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

6. FIRE HAZARDS (Continued)

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

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
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): 1.069
12.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 X 10⁴ J/kg
12.13 Heat of Combustion: -17,430 Btu/lb = -8686 cal/g = -405.5 X 10⁴ 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

TRICHLOROETHANE

TCE

<p>Common Synonyms</p> <p>1,1,1-Trichloroethane Methylchloroform Aerothene Chlorothene</p>		<p>Watery liquid Colorless Sweet: poor</p> <p>Sinks in water. Irritating vapor is produced.</p>	
<p>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.</p>			
<p>Fire</p>		<p>Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, carbon dioxide, or foam.</p>	
<p>Exposure</p>		<p>CALL FOR MEDICAL AID.</p> <p>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.</p> <p>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.</p>	
<p>Water Pollution</p>		<p>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.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment</p>		<p>2. LABEL</p> <p>2.1 Category: None 2.2 Class: Not pertinent</p>	
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: C₂HCl₃ 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2831 3.5 CAS Registry No.: 71-55-6</p>		<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Chloroform-like, sweetish</p>	
<p>5. HEALTH HAZARDS</p> <p>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 footcups); neoprene or polyvinyl alcohol suit or apron for splash protection.</p> <p>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.</p> <p>5.3 Treatment of Exposure: Get medical attention for all eye exposures and any other serious over-exposures. 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.</p> <p>5.4 Threshold Limit Value: 350 ppm 5.5 Short Term Inhalation Limit: 1,000 ppm for 60 min. in man 5.6 Toxicity by Ingestion: Grade 1; LD₅₀ = 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</p>			

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/TL₅₀/salt water *Time period not specified.
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

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

10. HAZARD ASSESSMENT CODE
(See Hazard Assessment Handbook)
A-X-Y

11. HAZARD CLASSIFICATIONS

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

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

11.3 NFPA Hazard Classification:

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 133.41
12.3 Boiling Point at 1 atm: 165°F = 74°C = 347°K
12.4 Freezing Point: <-38°F = <-39°C = <234°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.31 at 20°C (liquid)
12.8 Liquid Surface Tension: 25.4 dynes/cm = 0.0254 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 45 dynes/cm = 0.045 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 4.6
12.11 Ratio of Specific Heats of Vapor (Gas): 1.104
12.12 Latent Heat of Vaporization: 100 Btu/lb = 58 cal/g = 2.4 X 10⁴ J/kg
12.13 Heat of Combustion: (est.) 4700 Btu/lb = 2600 cal/g = 110 X 10⁴ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 4.0 psia

NOTES

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	79.670	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

<p>Common Synonyms</p> <p>Trichloroethylene Triclene, Algyen Chlorylene Gemaigene Triethylene Trichloran, Triene</p>		<p>Watery liquid Colorless Sweet odor</p> <p>Sinks in water. Irritating vapor is produced.</p>	
<p>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.</p>			
<p>Fire</p>		<p>Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, carbon dioxide, or foam.</p>	
<p>Exposure</p>		<p>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.</p>	
<p>Water Pollution</p>		<p>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.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment</p>		<p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p>	
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: $\text{CH}_2=\text{CCl}_2$ 3.3 IMO/UN Designator: 8.0/1710 3.4 DOT ID No.: 1710 3.5 CAS Registry No.: 79-01-6</p>		<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Chloroform-like; etheral</p>	
<p>5. HEALTH HAZARDS</p> <p>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.</p> <p>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.</p> <p>5.3 Treatment of Exposure: Do NOT administer adrenalin or epinephrine; 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.</p> <p>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</p>			

6. FIRE HAZARDS

6.1 Flash Point: 90°F C.C.; practically nonflammable
6.2 Flammable Limits in Air: 6.0%-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: 660 mg/l/40 hr/daphnia/kil/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 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: 131.39
12.3 Boiling Point at 1 atm: 189°F = 87°C = 360°K
12.4 Freezing Point: -123.5°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): 1.16
12.12 Latent Heat of Vaporization: 103 Btu/lb = 57.2 cal/g = 2.4 X 10⁴ 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
12.26 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		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	94.669	0	.220		N O T P E R T I N E N T	15	.800
5	94.410	10	.221			20	.775
10	94.150	20	.223			25	.750
15	93.889	30	.225			30	.727
20	93.629	40	.226			35	.705
25	93.370	50	.228			40	.684
30	93.110	60	.230			45	.664
35	92.849	70	.231			50	.645
40	92.589	80	.233			55	.627
45	92.330	90	.235			60	.610
50	92.070	100	.236			65	.593
55	91.809	110	.238			70	.577
60	91.549	120	.240			75	.562
65	91.290	130	.241			80	.548
70	91.030	140	.243			85	.534
75	90.770	150	.245			90	.521
80	90.509	160	.246			95	.508
85	90.250	170	.248			100	.496
90	89.990					105	.485
95	89.730					110	.474
100	89.469					115	.463
105	89.209					120	.453
110	88.950						
115	88.690						
120	88.429						
125	88.169						

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
77.02	.110	40	.508	40	.01245	0	.136
		50	.678	50	.01628	25	.139
		60	.894	60	.02105	50	.143
		70	1.166	70	.02695	75	.146
		80	1.507	80	.03418	100	.149
		90	1.929	90	.04296	125	.152
		100	2.448	100	.05354	150	.155
		110	3.081	110	.06619	175	.157
		120	3.846	120	.08120	200	.160
		130	4.765	130	.09891	225	.162
		140	5.862	140	.11960	250	.165
		150	7.163	150	.14380	275	.167
		160	8.695	160	.17180	300	.169
		170	10.490	170	.20390	325	.172
		180	12.580	180	.24080	350	.174
		190	15.010	190	.28280	375	.176
		200	17.810	200	.33040	400	.177
		210	21.020	210	.38420	425	.179
						450	.181
						475	.182
						500	.184
						525	.185
						550	.186
						575	.187
						600	.188

VINYL CHLORIDE

VCM

Common Synonyms Chlorethylene 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		<p>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.</p>		
Exposure		<p>CALL FOR MEDICAL AID.</p> <p>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.</p> <p>LIQUID Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS.</p>		
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 Limit: 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 smearing and reddening of skin. May cause frostbite.				
5.10 Odor Threshold: 260 ppm				
5.11 IDLH Value: Data not available				

6. FIRE HAZARDS		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-B-C-D-E-F-G-Z	
6.1 Flash Point: -110°F O.C.		11. HAZARD CLASSIFICATIONS	
6.2 Flammable Limits in Air: 4%-26%		11.1 Code of Federal Regulations: Flammable gas	
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.		11.2 NAS Hazard Rating for Bulk Water Transportation: Category Rating	
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent		Fire..... 4	
6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgenic, and carbon monoxide.		Health	
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.		Vapor Irritant..... 2	
6.7 Ignition Temperature: 862°F		Liquid or Solid Irritant..... 1	
6.8 Electrical Hazard: Class I, Group D		Poisons..... 2	
6.9 Burning Rate: 4.3 mm/min. <i>(Continued)</i>		Water Pollution	
7. CHEMICAL REACTIVITY		Human Toxicity..... 0	
7.1 Reactivity With Water: No reaction		Aquatic Toxicity..... 0	
7.2 Reactivity with Common Materials: No reaction		Aesthetic Effect..... 0	
7.3 Stability During Transport: Stable		Reactivity	
7.4 Neutralizing Agents for Acids and Bases: Not pertinent		Other Chemicals..... 2	
7.5 Polymerization: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.		Water..... 0	
7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.		Self Reaction..... 2	
7.7 Molar Ratio (Reactant to Product): Data not available		11.3 NFPA Hazard Classification: Category Classification	
7.8 Reactivity Group: 35		Health Hazard (Blue)..... 2	
8. WATER POLLUTION		Flammability (Red)..... 4	
8.1 Aquatic Toxicity: None		Reactivity (Yellow)..... 1	
8.2 Waterfowl Toxicity: None		12. PHYSICAL AND CHEMICAL PROPERTIES	
8.3 Biological Oxygen Demand (BOD): None		12.1 Physical State at 15°C and 1 atm: Gas	
8.4 Food Chain Concentration Potential: None		12.2 Molecular Weight: 62.50	
9. SHIPPING INFORMATION		12.3 Boiling Point at 1 atm: 7.2°F = 13.6°C = 255.4°K	
9.1 Grades of Purity: Commercial or technical 99+%		12.4 Freezing Point: -244.8°F = -153.6°C = -119.4°K	
9.2 Storage Temperature: Under pressure; ambient at atm. pressure; low		12.5 Critical Temperature: 317.1°F = 158.4°C = 431.6°K	
9.3 Inert Atmosphere: No requirement		12.6 Critical Pressure: 775 psia = 52.7 atm = 5.34 MN/m ²	
9.4 Venting: Under pressure; safety relief at atm. pressure; pressure-vacuum		12.7 Specific Gravity: 0.968 at -13°C (liquid)	
6. FIRE HAZARDS (Continued)		12.8 Liquid Surface Tension: 16.0 dynes/cm = 0.0160 N/m at 25°C	
6.10 Adiabatic Flame Temperature: Data not available		12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.03 N/m at 20°C	
6.11 Stoichiometric Air to Fuel Ratio: 5.490 (Est.)		12.10 Vapor (Gas) Specific Gravity: 2.2	
6.12 Flame Temperature: Data not available		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 10 ⁴ J/kg	
		12.13 Heat of Combustion: -8136 Btu/lb = -4520 cal/g = -189.1 X 10 ⁴ 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 10 ⁴ J/kg	
		12.25 Heat of Fusion: 18.14 cal/g	
		12.26 Limiting Value: Data not available	
		12.27 Reid Vapor Pressure: 75 psia	

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		N O T P E R T I N E N T	-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

<p>Common Synonyms 1,3-Dimethylbenzene Xylol</p>	<p>Watery liquid Colorless Sweet odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>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.</p>	
Fire	<p>FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area.</p> <p>Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
Exposure	<p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness.</p> <p>Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>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.</p>
Water Pollution	<p>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.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area Should be removed Chemical and physical treatment</p>	<p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: m-C₈H₁₀(CH₃)₂ 3.3 IMO/UN Designator: 3.2/1307 3.4 DOT ID No.: 1307 3.5 CAS Registry No.: 106-38-3</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Like benzene; characteristic aromatic</p>
<p style="text-align: center;">5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.</p> <p>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.</p> <p>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.</p> <p>5.4 Threshold Limit Value: 100 ppm</p> <p>5.5 Short Term Inhalation Limits: 300 ppm for 30 min.</p> <p>5.6 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 g/kg</p> <p>5.7 Late Toxicity: Kidney and liver damage.</p> <p>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.</p> <p>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.</p> <p>5.10 Odor Threshold: 0.05 ppm</p> <p>5.11 IDLH Value: 10,000 ppm</p>	

<p style="text-align: center;">6. FIRE HAZARDS</p> <p>6.1 Flash Point: 84°F C.C. 6.2 Flammable Limits in Air: 1.1%-6.4% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 986°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>	<p style="text-align: center;">7. CHEMICAL REACTIVITY</p> <p>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</p>
<p style="text-align: center;">8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 0% (theor.), 8 days 8.4 Food Chain Concentration Potential: Data not available</p>	
<p style="text-align: center;">9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Research: 99.99%; Pure: 99.8%; Technical: 99.2% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>	

<p style="text-align: center;">10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>																																				
<p style="text-align: center;">11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant.....</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td>1</td> </tr> <tr> <td>Poisons.....</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity.....</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td>2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals.....</td> <td>1</td> </tr> <tr> <td>Water.....</td> <td>0</td> </tr> <tr> <td>Self Reaction.....</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td>2</td> </tr> <tr> <td>Flammability (Red).....</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td>0</td> </tr> </tbody> </table>	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	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	3	Reactivity (Yellow).....	0
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Reactivity (Yellow).....	0																																			
<p style="text-align: center;">12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.16 12.3 Boiling Point at 1 atm: 269.4°F = 131.9°C = 405.1°K 12.4 Freezing Point: -54.2°F = -47.9°C = 225.3°K 12.5 Critical Temperature: 650.8°F = 343.8°C = 617.0°K 12.6 Critical Pressure: 513.8 atm = 34.95 psia = 3,540 MN/m² 12.7 Specific Gravity: 0.864 at 20°C (liquid) 12.8 Liquid Surface Tension: 26.6 dynes/cm = 0.0286 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 N/m at 30°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.43 X 10⁴ J/kg 12.13 Heat of Combustion: -17,554 Btu/lb = -8752.4 cal/g = -406.31 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 26.01 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.34 psia</p>																																				
<p>NOTES</p>																																				

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

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

<p>Common Synonyms 1, 2-Dimethylbenzene Xylo</p>	<p>Watery liquid Colorless Sweet odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>	
<p>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.</p>		
<p>Fire</p>	<p>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.</p>	
<p>Exposure</p>	<p>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.</p>	
<p>Water Pollution</p>	<p>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.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area Should be removed Chemical and physical treatment</p>		<p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: $C_{10}H_{12}$ 3.3 IMO/UN Designation: 3.2/1307 3.4 DOT ID No.: 1307 3.5 CAS Registry No.: 95-47-6</p>		<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Benzene-like; characteristic aromatic</p>
<p>5. HEALTH HAZARDS</p>		
<p>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 Limit: 300 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD₅₀ = 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</p>		

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 63°F C.C.; 75°F O.C. 6.2 Flammable Limits in Air: 1.1%-7.0% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 869°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>																																				
<p>7. CHEMICAL REACTIVITY</p> <p>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</p>	<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Health.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Vapor Irritant.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Poisons.....</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Water Pollution.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Human Toxicity.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Reactivity.....</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Other Chemicals.....</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Water.....</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Self Reaction.....</td> <td style="text-align: right;">0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue).....</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Flammability (Red).....</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td style="text-align: right;">0</td> </tr> </tbody> </table>	Category	Rating	Fire.....	3	Health.....	1	Vapor Irritant.....	1	Liquid or Solid Irritant.....	1	Poisons.....	2	Water Pollution.....	1	Human Toxicity.....	1	Aquatic Toxicity.....	3	Aesthetic Effect.....	2	Reactivity.....	0	Other Chemicals.....	1	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	2	Flammability (Red).....	3	Reactivity (Yellow).....	0
Category	Rating																																				
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Flammability (Red).....	3																																				
Reactivity (Yellow).....	0																																				
<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: >100 mg/l/96 hr/D, magna/TL₀₁/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 0 lb/5 days; 2.5% (theor.), 8 days 8.4 Food Chain Concentration Potential: Data not available</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>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 = 36.64 psia = 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): 1.068 12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47 X 10⁴ J/kg 12.13 Heat of Combustion: -17,558 Btu/lb = -9754.7 cal/g = -406.41 X 10³ 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: 30.64 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.26 psia</p>																																				
<p>9. SHIPPING INFORMATION</p> <p>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</p>																																					
<p>NOTES</p>																																					

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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

p-XYLENE

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Common Synonyms 1. 4-Dimethylbenzene Xylol		Watery liquid Colorless Sweet odor
Floats on water. Flammable, irritating vapor is produced. Freezing point is 56°F.		
Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.	
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: $p-C_6H_4(CH_3)_2$ 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
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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_{50} /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: 99.8%; Technical: 99.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum
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10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U
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11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>1</td> </tr> <tr> <td>Poisons</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect</td> <td>2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>1</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> 11.3 NFPA Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>2</td> </tr> <tr> <td>Flammability (Red)</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>	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	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	3	Reactivity (Yellow)	0
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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 = 266.5°K 12.5 Critical Temperature: 649.4°F = 343.0°C = 616.2°K 12.6 Critical Pressure: 509.4 atm = 34.65 psia = 3.510 MN/m ² 12.7 Specific Gravity: 0.861 at 20°C (liquid) 12.8 Liquid Surface Tension: 28.3 dynes/cm = 0.0283 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 37.8 dynes/cm = 0.0378 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 150 Btu/lb = 81 cal/g = 3.4×10^4 J/kg 12.13 Heat of Combustion: -17,559 Btu/lb = -8754.7 cal/g = -406.41×10^4 J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 37.83 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.34 psia

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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

APPENDIX D

**NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
METHODOLOGY FOR CADMIUM AND CHROMIUM MONITORING**

Monitoring for Cadmium

Personal monitoring will be undertaken to characterize the worker's exposure to cadmium. This will be done by monitoring representative employees for cadmium. Employee selection will be based on work task and duration of exposure. Sampling and analysis will be done in accordance with the NIOSH methodology and is summarized below. The Health and Safety Manager (HSM) and Health and Safety Supervisor (HSS) should be contacted prior to sampling.

1. One worker per task will be selected. The worker selected will be the one thought to have the greatest exposure to cadmium for the longest duration (if two workers have equal exposures, personal monitoring can be rotated each day). The exposures to all other workers is assumed to be the same as the chosen individual or lower. The name, social security number, job classification, and company of all workers represented by the sample are to be recorded; additionally, the date(s), number, duration, and location of each of the samples taken, including a description of the sampling procedure used (to determine representative employee exposure, where applicable) are to be recorded. The type of respiratory protection worn, if any, and any environmental variables (e.g., rain, mist, or wind) that could affect the measurement of employee exposure are also to be recorded.
2. Full shift (at least 7 hours) breathing zone samples will be conducted using personal sampling pumps, calibrated before and after each use and set at 1 liter per minute. Minimum sample volume is 200 liters. Two- or three-piece mixed cellulose-ester acetate membrane (MCE) filters with 0.8 micrometer pore size and 37 millimeter (mm) diameter will be used to collect the sample.
3. Samples will be collected and shipped together along with two open and two closed blanks. Open blanks are filter cassettes that are handled in the same manner as the samples, except that no air is drawn through them. Closed blanks are media blanks to ensure the cassettes are not contaminated. Two open blanks per sample are required; therefore, if more than 10 samples are taken, additional blanks must be added. Samples should be analyzed using NIOSH method 7300 (inductively coupled plasma atomic emission spectroscopy).
4. At least one sample per task per site location will be taken in the initial monitoring phase. If the results show cadmium levels below 0.025 milligram per cubic meter (mg/m^3), no further testing will be required in that area for that task. If levels are found to be above $0.025 \text{ mg}/\text{m}^3$, repeat testing may be needed if task duration is longer than 6 months. If conditions or tasks change that may result in new or additional exposures to cadmium, additional sampling events will occur.
5. All affected workers (both ABB-ES and subcontractor personnel) will be notified in writing of the results of the analysis within 15 working days of their receipt. Affected workers include not only the worker wearing the pump and filter, but also the others working in the same general area.

Monitoring for Total Chromium

Personal monitoring will be undertaken to characterize worker exposure to chromium. This will be done by monitoring representative employees for chromium. Employee selection will be based on work task and duration of exposure. Sampling and analysis will be done in accordance with NIOSH methodology and is summarized below. Contact HSM and the HSS prior to sampling.

1. One worker per task will be selected. The worker selected will be the one thought to have the greatest exposure to chromium for the longest duration (if two workers have equal exposures, personal monitoring can be rotated each day). The exposures to all other workers is assumed to be the same as the chosen individual, or lower. The name, social security number, job classification, and company of all workers represented by the sample are to be recorded. Additionally, the date(s), number, duration, and location of each of the samples taken, including a description of the sampling procedure used (to determine representative employee exposure, where applicable) are to be recorded. The type of respiratory protection worn, if any, and any environmental variables (e.g., rain, mist, wind) that could affect the measurement of employee exposure are also to be recorded.
2. Full shift (at least 7 hours) breathing zone samples will be conducted using personal sampling pumps, calibrated before and after each use and set at 1 liter per minute. Minimum sample volume is 10 liters. Three-piece mixed MCE filters with 0.8 micrometer pore size and 37 mm diameter will be used to collect the samples.
3. Samples will be collected and shipped together along with two open and two closed blanks. Open blanks are filter cassettes that are handled in the same manner as the samples, except that no air is drawn through them (remove the end caps, place in a clean area or bag, and recap with samples). Closed blanks are media blanks to ensure the cassettes are not contaminated prior to purchase. Two open blanks are needed per 10 samples; therefore, if more than 10 samples are taken, additional blanks will be needed. Samples should be analyzed using NIOSH method 7024 (atomic absorption, flame).
4. At least one sample per task per site location will be taken in the initial monitoring phase. If the results show chromium levels below 0.25 mg/m^3 , no further testing will be required in that area for that task.* If levels are found to be above 0.25 mg/m^3 , repeat testing may be needed. If changes to conditions or tasks may result in new or additional exposures to chromium, additional samples will be taken.

***NOTE:** If there is a potential for hexavalent chromium to be present, personal sampling for hexavalent chromium must be conducted if results exceed 0.05 mg/m^3 .

5. All affected workers (both ABB-ES and subcontractor personnel) will be notified in writing of the results of the analysis. Affected workers include not only those wearing the pump and filter, but also those working in the same general area.

APPENDIX E

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

(404) 347-3573
(617) 565-7164
(312) 353-2220
(214) 767-4731
(303) 844-3061
(816) 426-5861
(212) 337-2378
(215) 596-1201
(415) 744-6670
(206) 442-5930

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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.