



# MATERIAL SAFETY DATA SHEET

## Chlorine

### SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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**Product Name:** Chlorine  
**CAS#:** 7782-50-5  
**MSDS Code:** Cl2-e  
**Product Use:** Disinfection of water, plastics production, bleaching processes in pulp and paper, production of chlorinated compounds  
**ANSI/NSF Standard 60 Maximum Dose for Potable Water:** 30 mg/L

**Major Update:** 08/18/99  
**Minor Revision:** 11/05/99

### Emergency Contacts (24 hr.)

FOR EMERGENCIES INVOLVING CHEMICAL SPILL OR RELEASE, CALL  
**1-888-306-7070.**

### SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Ingredient(s)	% (w/w)	ACGIH	CAS NO.
Chlorine	99-100	0.5 ppm - TWA 1 ppm - STEL	7782-50-5

### SECTION 3 - HAZARD IDENTIFICATION

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**Emergency Overview:** Greenish-yellow gas or clear amber liquid (under pressure) with a pungent odor. COMPRESSED GAS. STRONG OXIDIZER. Contact with combustible materials may cause fire or explosion. Reacts violently or explosively with many substances. Reacts with water to form corrosive hydrochloric and hypochlorous acids. Confined space hazard. VERY TOXIC. May be fatal if inhaled. Extremely irritating to the respiratory tract. Causes lung injury and effects may be delayed. CORROSIVE to the eyes and skin. Liquefied gas can cause frostbite and corrosive injury to the eyes and skin. Burns and permanent damage, including blindness may result. Very toxic to aquatic organisms. Can cause damage to vegetation. Read the entire MSDS for a more thorough evaluation of the hazards.

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**Potential Health Effects:**

**General :** Chlorine normally exists as a gas at room temperature and the most important route of exposure is inhalation, followed by eye and skin exposures. Liquefied chlorine can freeze skin tissues.

**Inhalation :** Chlorine is a severe nose, throat and upper respiratory tract irritant. People exposed to chlorine, even for short periods of time, can develop a tolerance to its odor and irritating properties. In mild exposures, clinical signs include rhinorrhea, cough, headache, sore throat, chest pain, dyspnea, nausea and pulmonary function deficits. After more severe exposures, clinical signs include ulcerative tracheobronchitis, pulmonary edema, respiratory failure and death.

The following is a listing of chlorine exposure thresholds and estimated clinical effects:

- 0.2-0.4 ppm – odor threshold (with considerable variation among subjects) (decrease in odor perception occurs over time).
- 1-3 ppm-mild, mucous membrane irritation, tolerated up to 1 hr.
- 5-15 ppm – moderate irritation of the respiratory tract
- 30 ppm – immediate chest pain, vomiting, dyspnea, cough
- 40-60 ppm – toxic pneumonitis and pulmonary edema
- 430 ppm – lethal over 30 minutes
- 1000 ppm – fatal within a few minutes

**Skin Contact:** Airborne gas may irritate and burn the skin. Direct contact with the liquefied gas escaping from its pressurized cylinder can cause frostbite. Symptoms of mild frostbite include numbness, prickling and itching in the affected area. Symptoms of more severe frostbite include a burning sensation and stiffness of the affected area. The skin may become waxy white or yellow.

**Eye Contact:** Chlorine gas is a severe eye irritant. Stinging, a burning sensation, rapid blinking, redness and watering of the eyes have been observed at concentrations of 1 ppm and higher. Direct contact with liquefied chlorine escaping from its high-pressure cylinder may cause frostbite. Burns and permanent damage, including blindness may result.

**Ingestion:** Ingestion is not an applicable route of exposure for gases.

**Existing Medical Conditions Possibly Aggravated By Exposure:** Asthma, bronchitis, emphysema and other lung diseases and chronic nose, sinus or throat, and cardiac conditions.

**Chronic Effects:** A small number of human population studies conducted have not shown significant respiratory system effects in workers with long-term, low-level (typically less than 1 ppm) chlorine exposure. One study examined 332 workers exposed to time-weighted average (TWA) concentrations of between 0.006 and 1.42 ppm (0.15 ppm average) for an average of 10.9 years. No relationship was found between exposure to chlorine and the occurrence of colds, breathing difficulties, and abnormal heartbeat or chest pain. Significant effects on lung function were not observed. Studies of workers who have had experienced one or more exposures to chlorine which produced short-term health effects tend to show long-term lung dysfunction.

**Carcinogenicity:** Chlorine is not classified as carcinogenic by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as carcinogens by OSHA (Occupational Safety and Health Administration), and not listed as carcinogens by NTP (National Toxicology Program).

**SECTION 4 – FIRST AID MEASURES**

**Inhalation:** Take proper precautions to ensure your own safety before attempting rescue (e.g., wear appropriate protective equipment, use the buddy system). Remove source of contamination or move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on doctor's advice. DO NOT allow victim to move about unnecessarily. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure. Apply artificial respiration if victim is not breathing. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Give Cardiopulmonary Resuscitation (CPR) if there is no pulse AND no breathing. Obtain medical attention IMMEDIATELY.

**Skin Contact:** Quickly remove victim from source of contamination and flush with lukewarm, gently flowing water for 15 minutes. Liquefied Gas: DO NOT attempt to rewarm the affected area on site. DO NOT rub area or apply dry heat. Gently remove clothing or jewelry that may restrict circulation. Carefully cut around clothing that sticks to the skin and remove the rest of the garment. Loosely cover the affected area with a sterile dressing. DO NOT allow victim to drink alcohol or smoke. Obtain medical attention IMMEDIATELY.

**Eye Contact:** Immediately flush eyes with lukewarm running water for 15 minutes. If a burn exists, cover both eyes with a sterile dressing. Obtain medical attention IMMEDIATELY.

**Ingestion :** Ingestion is not an applicable route of exposure for gases.

**Note to Physicians:** Following exposure the patient should be kept under medical review for at least 48 hours as delayed pulmonary edema may occur.

**SECTION 5 – FIRE FIGHTING MEASURES**

<b>Flash Point</b>	Does not burn, but is a strong oxidizer and a serious fire risk.
<b>Flammable Limits (Lower)</b>	Not applicable
<b>Flammable Limits (Upper)</b>	Not applicable
<b>Auto Ignition Temperature</b>	Not applicable
<b>Decomposition Temperature</b>	Not available
<b>Combustion and Thermal Decomposition Products</b>	Toxic chemicals are formed when combustible materials burn in chlorine. These may include corrosive hydrogen chloride gas, free chlorine gas and other chlorine compounds.
<b>Rate of Burning</b>	Not applicable
<b>Explosive Power</b>	Not applicable
<b>Sensitivity to Mechanical Impact</b>	Not sensitive

**Fire and Explosion Hazards:** Chlorine does not burn. However, chlorine is a strong oxidizing agent and poses a serious fire and explosion risk because it promotes combustion, like oxygen. Most combustible materials will ignite and/or burn in chlorine atmospheres, forming irritating and toxic gases. Containers or cylinders may rupture violently due to over-pressurization, if exposed to fire or excessive heat for a sufficient period of time. Intense local heat (above 200 °C) on the

steel walls of chlorine cylinders can cause an iron/chlorine fire resulting in rupture of the container. Cylinder and ton containers will vent through fusible plugs at 71°C (160°F). Chlorine gas is heavier than air and will collect and persist in pits, hollows, depressions, and other confined or low-lying areas.

**Extinguishing Media:** Use extinguishing media appropriate to surrounding fire conditions, such as dry chemical powder, carbon dioxide, or foam.

**Fire Fighting Procedures:** Apply water from as far a distance as possible, in flooding quantities as a spray or fog to keep fire-exposed cylinders, containers or equipment cool and absorb heat, until well after the fire is out. If there is a chlorine leak, stop the flow of gas, if this can be done safely. A chlorine fire can be extinguished only by stopping the flow of chlorine gas. Use water spray to protect personnel attempting to shut off the flow. Remove all flammable and combustible materials from the vicinity, especially oil and grease. Use water with caution. Do not apply water directly to the liquefied or gaseous chlorine. Reverse flow into cylinder may cause rupture. Take care not to block pressure relief valves. Stay away from ends of tanks (but realize that shrapnel may travel in any direction). In an advanced or massive fire, the area should be evacuated; use unmanned hoseholders or monitor nozzles.

**Fire Fighting Protective Equipment:** Use specialized protective equipment suitable for the situation. Firefighter's normal protective clothing (Bunker Gear) will not provide adequate protection. A full-body encapsulating chemical resistant suit with positive pressure self-contained breathing apparatus (MSHA/NIOSH approved or equivalent) may be necessary.

**Evacuation:** If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

**NOTE:** Also see "Section 10 - Stability and Reactivity"

## SECTION 6 - ACCIDENTAL RELEASE MEASURES

### Spills, Leaks, or Releases:

- Restrict access to area until completion of clean up. Ensure trained personnel conduct clean up.
- Wear adequate personal protective equipment including respiratory protection.
- Remove all combustible and flammable materials
- Remove all ignition sources (no smoking, flares, sparks or flames). All equipment should be grounded. Ventilate area.
- Stop leak if possible without personal risk. Emergency kits are available for handling chlorine leaks in cylinders, tank cars and tank trailers. All personnel must be trained in their particular usage. This information is available from the Chlorine Institute.
- Large leaks: Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Prevent entry into sewers and confined areas. Vapor knock down water is corrosive and toxic, thus it should be diked for containment. Ensure compatible materials are used.
- Leaking cylinder: Only to be conducted by trained personnel. Emergency kits are available for handling leaking chlorine cylinders. Contents may also be disposed of to a safe out of doors area or a hood with forced ventilation. Attach appropriate control valve provided with a trap or check valve and a long piece of flexible hose connected to the valve outlet. Discharge the gas at a moderate rate into an adequate amount of about 15% aqueous sodium hydroxide or other alkali

or reducing solution in suitable container. When all the gas is discharged, close the cylinder valve and tag the cylinder as defective. Dispose of waste according to local environmental regulations. Also, see "Section 7 - Handling and Storage".

**Deactivating Chemicals:** Sodium hydroxide; soda ash; hydrated lime - followed by a reducing agent. See Incompatibles in Section 10.

**Waste Disposal Methods:** Dispose of waste material at an approved waste treatment/disposal facility, in accordance with applicable regulations. Do not dispose of waste with normal garbage or to sewer systems.

Note - Clean-up material may be a RCRA Hazardous Waste on disposal.

- Releases are subject to CERCLA reporting requirements: RQ = 10 lb. (4.54 kg).

## SECTION 7 - HANDLING AND STORAGE

**Handling:** Take all precautions to avoid personal contact. Prevent the release of gas into workplace air. Always ensure adequate ventilation in handling areas. Locate safety shower and eyewash station close to chemical handling area. Keep away from incompatibles, heat, sparks, flames and other ignition sources. Locate safety shower and eyewash station fairly close to chemical handling area. Only auxiliary valves and gauges designed solely for chlorine gas should be used. Do NOT use stainless steel equipment. Open and shut valves to cylinders at least once a day, while cylinder is in use to avoid valve freezing. Secure containers at all times. Leaks should be fixed promptly. Vapors are heavier than air. Prevent liquid or vapor from entering sewers, sumps or pit areas. Vapors can create a toxic atmosphere, which may be fatal. Use self-contained breathing apparatus to avoid suffocation.

**Storage:** Store in a cool, dry, well-ventilated area, out of direct sunlight, away from heat, away from flammable materials, incompatibles and away from process and handling areas. Do not store near elevators, corridors or loading docks. Do not store below ground level or in confined spaces. Storage area should be clearly identified, clear of obstruction and accessible only to trained and authorized personnel. Post warning signs. Inspect periodically for damage or leaks. Keep quantities stored as small as possible. For large-scale storage of this material consider the installation of a leak detection system with an alarm. Facilities for the emergency disposal of chlorine from leaking containers should be provided in storage areas. Avoid storage of cylinders for more than six months. Use the oldest first. Compressed gas cylinders should be stored separately according to their chemical hazards. This material is highly reactive. Always store in original labeled cylinder, or in the type of container recommended by the manufacturer/supplier. Keep cylinders tightly closed when not in use and when empty. Cylinder valves should be tightly closed. Cylinder valve caps should be properly secured. Always check cylinder valve for evidence of damage, rust or dirt, which may inhibit operation. Always chain or otherwise securely restrain cylinders in an upright position to a wall, rack or other solid structure when they are stored. Store empty cylinders separate from full ones with valves shut off, cap secure and labeled EMPTY or "MT". Empty containers may contain hazardous residues.

Outdoor cylinder storage should be weatherproofed and have proper drainage. Have appropriate fire extinguishers and leak clean-up equipment in storage area.

**Storage Temperature:** Protect from temperature extremes. (Never expose cylinders to temperatures higher than 52 ° C (125 ° F) or below -29 ° C (-20 ° F) unless they are designed for this.

**Other Precautions:** Walls, floors, shelving, fittings, lighting and ventilation systems in storage area should be made from materials that do not react with chlorine. Below 121 ° C (250 ° F), iron, copper, steel, lead, nickel, platinum, silver and tantalum are resistant to dry chlorine gas or liquid. Storage facilities should be made of fire-resistant materials.

## SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

### PREVENTIVE MEASURES

**Recommendations listed in this section indicate the type of equipment, which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.**

**Engineering Controls:** Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. The most effective measures are the total enclosure of processes and the mechanization of handling procedures to prevent all personal contact with chlorine. Because of the high potential hazard associated with this substance, stringent control measures such as enclosure or isolation are recommended when dealing with large quantities. Systems must be kept "dry" to prevent metal corrosion.

### PERSONAL PROTECTIVE EQUIPMENT

**Eye Protection:** Use full face-shield and chemical safety goggles when there is potential for contact. Maintain eye wash fountain and quick-drench facilities in work area.

**Skin Protection:** If contact with liquid or gas is possible, then use chemical protective gloves, coveralls, boots and/or other resistant protective clothing. Have a safety shower/eye-wash fountain readily available in the immediate work area. Some operations may require the use of a chemical protective full-body encapsulating suit and respiratory protection.

***Resistance of Materials for Protective Clothing:*** Guidelines for chlorine, liquid:

- RECOMMENDED (resistance to breakthrough longer than 8 hours): Responder (TM), Tychem 10000 (TM).

Guidelines for chlorine, gas:

- RECOMMENDED (resistance to breakthrough longer than 8 hours): Butyl rubber, Neoprene, Teflon(TM), Viton(TM), Saranex(TM), Barricade(TM), CPF 3(TM), Responder(TM), Trelchem HPS(TM), Tychem 10 000(TM).
- RECOMMENDED (resistance to breakthrough longer than 4 hours): Nitrile rubber, 4H(TM)(PE/EVAL).
- NOT RECOMMENDED for use (resistance to breakthrough less than 1 hour): Polyethylene, Polyvinyl Chloride.

Recommendations are NOT valid for very thin Natural rubber, Neoprene, Nitrile and PVC gloves (0.3 mm or less).

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Recommendations are valid for permeation rates reaching 0.1 ug/cm<sup>2</sup>/min or 1 mg/m<sup>2</sup>/min and over. Resistance of specific materials can vary from product to product. Breakthrough times are obtained under conditions of continuous contact, generally at room temperature. Evaluate resistance under conditions of use and maintain clothing carefully.

**Respiratory Protection:** NIOSH recommendations for chlorine concentrations in air:

- UP TO 5 ppm: Chemical cartridge respirator with cartridge(s) to protect against chlorine; or supplied-air respirator (SAR).
- UP TO 10 ppm: SAR operated in a continuous flow mode\*; or powered air-purifying respirator with cartridge(s) to protect against chlorine; or full-facepiece chemical cartridge respirator with cartridge(s) to protect against chlorine; or gas mask with canister to protect against chlorine; or full-facepiece self-contained breathing apparatus (SCBA); or full-facepiece SAR.
- Emergency or planned entry in unknown concentration or Immediately Dangerous to Life or Health (IDLH) conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
- Escape: Mouth bit or cartridge respirator with approved chlorine cartridge; or gas mask with canister to protect against chlorine; or escape-type SCBA.

\*NOTE: may require eye protection.

## EXPOSURE GUIDELINES

### **PRODUCT: Chlorine:**

ACGIH Time Weighted Average (TLV-TWA) :	0.5 ppm (1.5 mg/m <sup>3</sup> )
ACGIH Short Term Exposure Limit (STEL)	1.0 ppm (3.0 mg/m <sup>3</sup> )
OSHA Time Weighted Average (PEL-TWA)	0.5 ppm (1.5 mg/m <sup>3</sup> )
Immediately Dangerous to Life and Health (IDLH):	10 ppm

### AIHA- Emergency Response Planning Guidelines (ERPGs)

*ERPGs are for community emergency planning limits and not workplace exposure limits.*

ERPG-1	: 1 ppm
ERPG-2	: 3 ppm
ERPG-3	: 20 ppm

The ERPG-1 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms, which could impair an individual's ability to take protective action.

The ERPG-3 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

**SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES**

<b>Alternate Name(s)</b>	Molecular chlorine
<b>Chemical Name</b>	Chlorine
<b>Chemical Family</b>	Halogen
<b>Molecular Formula</b>	Cl <sub>2</sub>
<b>Molecular Weight</b>	70.9
<b>Appearance</b>	Yellowish-green gas or clear amber colored liquid when liquefied.
<b>Odor</b>	Pungent odor
<b>pH</b>	1.5-2.0 (0.8% Aqueous Solution)
<b>% Volatile by Volume</b>	100
<b>Vapor Pressure</b>	673.1 kPa (6.64 atm)(97.6 psig) at ° (20°C); 1427 kPa (14.1 atm.) (207psig)5830 mm Hg @ 25°C (77°F)
<b>Vapor Density (Air = 1)</b>	2.47
<b>Boiling Point</b>	-29°F (-34°C)
<b>Freezing Point</b>	-150°F (-101°C)
<b>Solubility (Water) 68°F</b>	0.7%
<b>Specific Gravity</b>	1.467 at 0°C (32°F) and 368.9 kPa (saturated liquefied gas); 0.0032 at 0°C (gas) (water = 1)
<b>Critical Temperature</b>	291.2 ° F (143.75°C)
<b>Viscosity:</b>	Liquefied gas - 0.346 mPa.s at 20°C (68°F)

**SECTION 10 – STABILITY AND REACTIVITY**

**Hazardous Decomposition Products:** Chlorine reacts with water to form a corrosive solution of hydrochloric acid and hypochlorous acid, which can decompose to chlorine, oxygen and chloric acid.

**Chemical Stability:** Stable at room temperature

**Conditions to Avoid:** Temperatures greater than 121° C (250°F), and moisture.

**Incompatibility with other Substances:** Chlorine gas can react explosively with alcohols, ammonia and compounds, hydrocarbon gases (e.g. acetylene and ethylene), hydrogen, antimony trichloride and tetramethylsilane, aziridine, bromine pentafluoride, dioxygen difluoride, oxygen difluoride, fluorine, diborane, dichloro(methyl)arsine, disilyl oxide, ethylphosphine, strong reducing agents, aqueous sulfamic acid, stibine, synthetic rubber, tetraselenium tetranitride and white phosphorus. Chlorine gas ignites on contact with mono and di-alkali metal acetylides, copper acetylides, halocarbons (e.g. dichloromethane), metals (e.g. finely powdered aluminum, brass and copper foil, iron, potassium, sodium, tin and titanium), non-metals (e.g. boron, active carbon, phosphorous and silicon), iron, uranium and zirconium carbides, diethyl ether, diethyl zinc, metal and non-metal hydrides, phosphorus compounds, sulfides, tellurium, trialkyl boranes and tungsten dioxide.



**RCRA:** Test waste material for corrosivity, D002, prior to disposal.

**SECTION 14 - TRANSPORT INFORMATION**

	<b>TDG</b>	<b>DOT</b>
<b>Shipping Name</b>	Chlorine	Chlorine
<b>Hazard Class/Division</b>	2.3 5.1	2.3 (Poison Gas) 8 (Corrosive)
<b>Identification No.</b>	UN1017	UN1017
<b>Identification No.</b>	UN1017	UN1017
<b>Limit</b>	> 1000 kg	RQ = 10 lbs.

**Note:** TDG - Emergency Response Assistance Planning requirements of sections 7.16 - 7.19 must be met for quantities exceeding 1,000 kg or liters net per consignment.

**SPECIAL PROVISIONS :** 102. The consignor shall mark any shipping document accompanying a consignment of this product or substance in carload, container load or trailer-load quantities with the words "SPECIAL COMMODITY" or "MARCHANDISE SPECIALE" when this substance or product is transported by rail.

**DOT - Other Classifications:** Marine pollutant

**Transportation Emergency Telephone Number:** 1-888-306-7070

**SECTION 15 - REGULATORY INFORMATION**

**Canadian Classification**

**This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.**

**Controlled Products Regulations (WHMIS) Classification:**

- A - Compressed gas
- C - Oxidizing material
- D1A - Poisonous and infectious material - Immediate and serious effects - Very toxic
- D2A - Poisonous and infectious material - Other effects - Very toxic
- E - Corrosive material

**CEPA / Canadian Domestic Substances List (DSL):** On the Canadian Domestic Substances List (CEPA DSL).

**WHMIS Ingredient Disclosure List:** Confirmed A; Meets criteria for disclosure at 1% or greater.

**National Pollutant Release Inventory (NPRI):** Reporting required for 1999

**USA Classification**

**OSHA Classification:** Highly Hazardous Chemicals, Code of Federal Regulations (CFR) v.29 Part 1910, Section 1910.119

**TSCA Inventory Status:** Y

**SARA Regulations sections 313 and 40 CFR 372: Y**

**SARA Hazard Categories, SARA SECTIONS 311/312 (40CFR370.21):**

ACUTE: Y

CHRONIC: N

FIRE: N

REACTIVE: N

SUDDEN RELEASE: Y

OSHA PROCESS SAFETY (29CFR1910.119): Y

**CERCLA Reportable Quantity: RQ = 10 lbs.**

This product does not contain nor is it manufactured with ozone depleting substances.

**Other Regulations/Legislation which apply to this product:**

California Proposition 65: N

**Right -To-Know:** Illinois, Massachusetts, New Jersey, Pennsylvania

EEC CLASSIFICATION: T, R 23

EINECS: 231-959-5

**SECTION 16 – OTHER INFORMATION**

The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and PIONEER will not be liable for any damages, losses, injuries or consequential damages that may result from the use of or reliance on any information contained herein. This Material Safety Data Sheet is valid for three years.

**Revision Indicators:**

Δ In the left margin indicates a revision or addition of information since the previous issue.

**National Fire Protection Association (NFPA) Rating**

**Hazardous Materials Identification System (HMIS) Rating**

	NFPA	HMIS
HEALTH	4	3
FIRE	0	0
REACTIVITY	0	0
SPECIAL	oxidizer	

4= Extreme/Severe  
 3 = High/Serious  
 2 = Moderate  
 1 = Slight  
 0 = Minimum

**REFERENCES:**

1. RTECS-Registry of Toxic Effects of Chemical Substances, On-line search, Canadian

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- Centre for Occupational Health and Safety RTECS database, Doris V. Sweet, Ed., National Institute for Occupational Safety and Health, U.S. Dept. of Health and Human Services, Cincinnati, Entry Update/May 1999
2. Transport Of Hazardous Materials (49CFR), Canadian Centre for Occupational Health and Safety, Issue : 99-2 (May, 1999)
  3. The Chlorine Institute, Inc., "Molecular Chlorine: Health and Environmental Effects", Pamphlet 90, Edition 2, November 1998
  4. "CHEMINFO", through "CCINFOdisc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, (May, 1999).
  5. Chemlist, STN Database, Chemical Abstract Service, Feb 1999
  6. DOSE, Royal Society of Chemistry, 1998.
  7. **HSDB-Hazardous Substances Data Bank** , through "CCINFO disc", Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, (May, 1999).
  8. NFPA 49 Hazardous Chemicals Data 1994 Edition, National Fire Protection Association, Quincy, MA, 1994
  9. NIOSH POCKET GUIDE TO CHEMICAL HAZARDS, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, June 1997
  10. "1999 Threshold Limit Values and Biological Exposure Indices", American Conference of Government Industrial Hygienists, 1999.
  11. TRANSPORT OF DANGEROUS GOODS (TDG), Canadian Centre for Occupational Health and Safety , \* Issue : 99-2 (May, 1999)

## Legend:

- AFFF - Aqueous Film Forming Foam  
CAS # - Chemical Abstracts Service Registry Number  
CERCLA- Comprehensive Environmental Response, Compensation, and Liability Act  
CFR - Code of Federal Regulations  
DOT - Department of Transportation  
EPA - Environmental Protection Agency  
LC50 - The concentration of material in air expected to kill 50% of a group of test animals  
MSHA - Mine Safety and Health Administration  
NIOSH - National Institute for Occupational Safety and Health  
PEL - Permissible Exposure Limit  
PVC - Polyvinyl chloride  
RCRA - Resource Conservation and Recovery Act  
SARA - Superfund Amendments and Reauthorization Act of the U.S. EPA  
TDG - Transportation of Dangerous Goods Act/Regulations  
TLV - Threshold Limit Value  
TSCA - Toxic Substances Control Act  
TWA - Time-Weighted Average

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