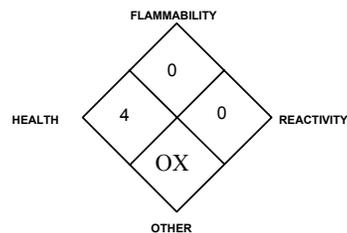


**NFPA RATING****MATERIAL SAFETY DATA SHEET***Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards***PART I** *What is the material and what do I need to know in an emergency?***1. PRODUCT IDENTIFICATION**

CHEMICAL NAME; CLASS: **CHLORINE - Cl₂**
Document Number: 001015

PRODUCT USE: For general analytical/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME: AIRGAS INC.
ADDRESS: 259 N. Radnor-Chester Road
 Suite 100
 Radnor, PA 19087-5283

BUSINESS PHONE: 1-610-687-5253
EMERGENCY PHONE: 1-800-949-7937
 International: 423-479-0293

DATE OF PREPARATION: May 6, 1996
REVISION DATE: May 25, 2001

2. COMPOSITION and INFORMATION ON INGREDIENTS

| CHEMICAL NAME | CAS # | mole % | EXPOSURE LIMITS IN AIR | | | | | |
|--------------------|-----------|---------|--|----------|---------------------------|-----------------------------|----------|--|
| | | | ACGIH | | OSHA | | IDLH ppm | OTHER |
| | | | TLV ppm | STEL ppm | PEL ppm | STEL ppm | | |
| Chlorine | 7782-50-5 | > 99.5% | 0.5, A4 (Not Classifiable as a Human Carcinogen) | 1 | 0.5 (Vacated 1989 PEL) | 1 C 1 (Vacated 1989 PEL) | 10 | NIOSH REL: C 0.5 ppm; DFG MAK: 0.5 ppm |
| Maximum Impurities | | < 0.5% | None of the trace impurities in this mixture contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards. | | | | | |

NE = Not Established

C = Ceiling Limit

See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Chlorine is a clear, pungent-smelling, green-yellow gas (or amber liquid) that is highly corrosive. Chlorine is irritating to the nose, throat, skin, and eyes. Inhalation of high concentrations of this gas can result in unconsciousness and death. High concentrations of Chlorine gas may cause an oxygen-deficient atmosphere. Chlorine is an oxidizer, which can act to initiate and sustain the combustion of flammable materials. Chlorine is heavier than air and pockets of this gas can accumulate in low-lying areas. Extreme caution must be used when responding to spills. Persons who respond to releases of Chlorine must protect themselves from inhalation of the Chlorine vapors and mists, especially in areas which are downwind of the release.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant route of overexposure for this gas is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

INHALATION: Inhalation of Chlorine vapors may lead to irritation of the nose and throat. Exposures to high concentrations of Chlorine gas can lead to symptoms such as coughing, labored breathing, sore throat, and in some instances, chemical pneumonitis and pulmonary edema. High concentrations of Chlorine gas may cause an oxygen-deficient atmosphere. Exposure to high concentrations may cause unconsciousness, and under some circumstances, death. Repeated chlorine overexposures by inhalation can result in emphysema and erosion of teeth. The symptoms associated with specific Chlorine concentrations are as follows:

| <u>CONCENTRATION</u> | <u>SYMPTOM OF EXPOSURE</u> |
|----------------------|--|
| 0.06 ppm : | Odor threshold. |
| 3 ppm: | Irritation of the eyes and mucous membranes. |
| 15 ppm: | Immediate irritation of the throat. |
| 50 ppm: | A dangerous health hazard, even for short periods of time. Prolonged exposure may result in death. |
| 1000 ppm: | Potentially fatal after a short exposure. |

CONTACT WITH SKIN or EYES: Contact of the liquid or gaseous product with the skin can lead to severe burns or dermatitis (red, cracked, irritated skin), depending upon concentration and duration of exposure. Contact of the liquid or gaseous product with the eyes can cause pain, redness, and prolonged exposure could cause blindness. Contact with the undiluted liquid will cause frostbite, ulceration of the skin (which may be delayed in appearance for several hours), blistering, and pain. Contact with rapidly expanding gas poses a frostbite hazard.

SKIN ABSORPTION: Skin absorption is not a significant route of exposure for Chlorine.

INGESTION: While ingestion of gaseous Chlorine is highly unlikely, ingestion of solutions containing Chlorine can damage the tissues of the mouth, throat, esophagus, and other tissues of the digestive system. Ingestion of Chlorine-containing solutions can be fatal. Additionally, aspiration by inhalation is possible, causing chemical pneumonia or death.

INJECTION: Injection is not a significant route of exposure for Chlorine.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms**. Overexposure to Chlorine may cause the following health effects:

ACUTE: This gas is extremely corrosive, and can burn and damage eyes, skin, mucous membranes, and any other exposed tissue. If Chlorine is inhaled, irritation of the respiratory system may occur, with coughing and breathing difficulty. Overexposure to this gas may be fatal.

CHRONIC: Persistent irritation may result from repeated exposures to this gas mixture. Repeated chlorine overexposures by inhalation can result in emphysema and erosion of tooth enamel.

TARGET ORGANS: Respiratory system, skin, eyes.

| HAZARDOUS MATERIAL INFORMATION SYSTEM | | | |
|---|---------------|---|---|
| HEALTH | | (BLUE) | 4 |
| FLAMMABILITY | | (RED) | 0 |
| REACTIVITY | | (YELLOW) | 0 |
| PROTECTIVE EQUIPMENT | | | H |
| EYES | RESPIRATORY | HANDS | BODY |
|  | SEE SECTION 8 |  |  |
| For routine industrial applications | | | |

See Section 16 for Definition of Ratings

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO CHLORINE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus should be worn, and possibly a chemical protective suit.

Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area of the body in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

SKIN EXPOSURE: If Chlorine contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

EYE EXPOSURE: If liquid is splashed into eyes, or if irritation of the eye develops after exposure to liquid or gas, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS:

Water Spray: YES

Carbon Dioxide: YES

Foam: YES

Dry Chemical: YES

Halon: YES

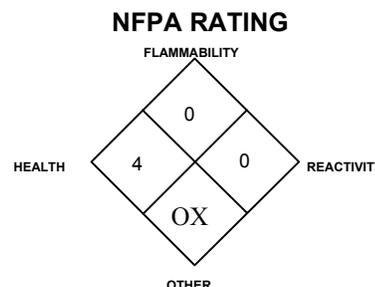
Other: Any "ABC" Class.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Chlorine is a toxic gas, which presents an extreme health hazard to firefighters. Chlorine is an oxidizer, which can act to initiate and sustain the combustion of flammable materials.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Move fire-exposed cylinders if it can be done without risk to firefighters. Otherwise, cool containers with hose stream and protect personnel. Withdraw immediately in case of rising sounds from venting safety device or any discoloration of tanks due to the fire. If Chlorine is involved in a fire, fire run-off water should be contained to prevent possible environmental damage.



See Section 16 for Definition of Ratings

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a large release, clear the affected area, protect people, and respond with trained personnel. Call CHLOREP via CHEMTREC (1-800-424-9300) for emergency assistance.

Minimum Personal Protective Equipment should be **Level A: triple-gloves (rubber gloves and nitrile gloves, over latex gloves), fully-encapsulating chemical resistant suit and boots, hard-hat, and Self Contained Breathing Apparatus.**

NOTE: Direct contact of liquid Chlorine with ANY personal protective equipment item can rapidly destroy the equipment, leading to injury and death.

6. ACCIDENTAL RELEASE MEASURES (Continued)

Chlorine leaks can be detected by means of an atomizer or squeeze bottle filled with aqueous ammonia. A white cloud will show the location of the leak. Monitor the surrounding area for Chlorine gas levels and oxygen. The Chlorine level must be below 0.5 ppm AND the atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or it is not possible to reach the valve), allow the gas to release in place or remove it to a safe area and allow the gas to be released there. Only attempt to install a Chlorine Emergency Kit (type A, B, or C) if you are familiar with the kit AND trained in its use. Never apply water to a chlorine leak.

THIS IS A CORROSIVE GAS. Protection of all personnel and the area must be maintained.

THIS IS A POISON GAS. All responders must be adequately protected from exposure.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Chlorine ON YOU or IN YOU. Wash hands after handling chemicals. Do not eat or drink while handling this material. Be aware of any signs of effects of exposure indicated in Section 3 (Hazard Identification); exposures to fatal concentrations of Chlorine could occur rapidly. All work practices should minimize the release of Chlorine.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Avoid breathing the gas or sprays or mists generated by Chlorine. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Use only compatible materials for cylinder, process lines, and other Chlorine-handling equipment. Lines should be purged with dry nitrogen both before and after maintenance activity. Chrome and aluminum are not suitable materials for use with Chlorine. Keep container tightly closed when not in use. Keep cylinders away from incompatible materials. Wash thoroughly after using this material. Workers must be thoroughly trained to handle Chlorine without causing overexposure. Periodic inspections of process equipment by knowledgeable persons should be made to ensure that the equipment is used appropriately and the system is kept in suitable operating condition. Chlorine emergency equipment should be available near the point of use.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Isolate from incompatible materials (see Section 10, Stability and Reactivity) for more information). Use a check valve or trap in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to work situations in which cylinders are being used:

During Use: Use designated regulators, CGA fittings, and other support equipment. Do not use adapters. Do not use oil or grease on gas handling fittings or equipment. All equipment must be properly grounded and bonded.

Chlorine cylinders should never be directly connected to a vessel containing a liquid since suckback may occur causing a violent reaction within the cylinder. To prevent suckback, a trap, check valve or vacuum break should be inserted into the line. The trap should be of adequate size to take the total liquid volume sucked back.

The rate of gas flow can be increased by improving air circulation about the container or by increasing the temperature of the room if it is below normal. Never apply heat directly to the cylinder for any reason. Do not manifold cylinders to increase output unless check valves have been inserted at the cylinder outputs to prevent exchange of material from one cylinder to another, causing a cylinder to become over-full.

Hoisting of cylinders is not recommended. If hoisting cannot be avoided, always use a lifting clamp, cradle, or carrier -- never use a lifting magnet, rope, or chain spring. Do not store chlorine cylinders near cylinders of hydrogen, acetylene, ammonia, fuel gases, ether, turpentine, hydrocarbons, organic matter, or finely divided metals. Never mix chlorine with other gases in the cylinder. Do not store chlorine cylinders near elevators or gangways or in locations where heavy objects may fall and strike them.

Open cylinder valves slowly. The use of large wrenches or pipe wrenches will damage the valve. One complete turn of the valve stem in a counter-clockwise direction opens the valve sufficiently to permit maximum discharge. "Empty" containers still contain Chlorine gas, and should be handled with all precautions described in this MSDS.

If leaks develop in Chlorine lines, they must be given prompt attention because they will become progressively worse. Refer to Section 6 (Accidental Release Measures) for release response protocol.

After Use: Close main cylinder valve. Replace valve protection cap (where provided). Mark empty cylinders "EMPTY".

7. HANDLING and STORAGE (Continued)

NOTE: Use only DOT or ASME code containers designed for Chlorine storage. Earth-ground and bond all lines and equipment associated with Chlorine. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. Additionally, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres" and NFPA Bulletin 58.

TANK CAR SHIPMENTS: Tank cars carrying Chlorine should be loaded and unloaded in strict accordance with tank-car manufacturer's recommendations and all established on-site safety procedures. Appropriate personal protective equipment must be used during tank car operations (see Section 8, Exposure Controls - Personal Protection). All loading and unloading equipment must be inspected, prior to each use. Loading and unloading operations must be attended, at all times. Tank cars must be level and wheels must be locked or blocked prior to loading or unloading. Tank car (for loading) or storage tank (for unloading) must be verified to be correct for receiving Chlorine and be properly prepared, prior to starting the transfer operations. Hoses must be verified to be clean and free of incompatible chemicals, prior to connection to the tank car or vessel. Valves and hoses must be verified to be in the correct positions, before starting transfer operations. A sample (if required) must be taken and verified (if required) prior to starting transfer operations. All lines must be blown-down and purged before disconnecting them from the tank car or vessel.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen) before attempting repairs.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. A hood with forced ventilation is preferable. Because of the high hazard associated with Chlorine, stringent control measures such as a gas cabinet enclosure or isolation may be necessary.

RESPIRATORY PROTECTION: Maintain airborne Chlorine concentrations below exposure limits listed in Section 2 (Composition and Information on Ingredients). If respiratory protection is needed, use only protection authorized in 29 CFR 1910.134 or applicable State regulations. Use supplied air respiration protection during emergency response procedures to releases. The following NIOSH respiratory protection recommendations for Chlorine are provided for additional information.

CONCENTRATION

RESPIRATORY EQUIPMENT

| | |
|---|---|
| Up to 5 ppm: | Chemical cartridge respirator with cartridge to protect against Chlorine or a Supplied Air Respirator (SAR). |
| Up to 10 ppm: | SAR in the continuous flow mode; or a Powered Air Purifying Respirator (PAPR) with chlorine cartridges; or full-facepiece chemical cartridge respirator with chlorine cartridge; a gas mask with a chlorine canister; or a full-facepiece Self-Contained Breathing Apparatus (SCBA); or full-facepiece SAR. |
| Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: | Positive pressure, full-facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA. |
| Escape: | Gas mask with canister or mount-piece respirator with Chlorine cartridges or escape-type SCBA. |

The IDLH concentration for Chlorine is 10 ppm.

HAND PROTECTION: Wear PVC, Teflon®, Kel-F®, or Neoprene Rubber gloves for industrial use. Use triple gloves for spill response (see Section 6, Accidental Release Measures). Wear mechanical resistant gloves when handling cylinders of Chlorine.

BODY PROTECTION: Use body protection appropriate for task. An apron, or other impermeable body protection is suggested. Full-body chemical protective clothing is recommended for emergency response procedures.

PROTECTION FOR TANK CAR OPERATIONS: Splash-suit, gloves, goggles, face-shield, boots and hard hat should be worn during operations involving tank-cars or trucks containing Chlorine.

NOTE: Direct contact of liquid Chlorine on ANY personal protective equipment item can rapidly destroy the equipment, leading to injury and death.

9. PHYSICAL and CHEMICAL PROPERTIES

VAPOR DENSITY: 2.98 kg/m³ (0.186 lb/ft³)

SPECIFIC GRAVITY (air = 1): 2.473

SOLUBILITY IN WATER: < 1%

VAPOR PRESSURE (psia): 100.0

EXPANSION RATIO: Not applicable.

SPECIFIC VOLUME (ft³/lb): 5.4

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

EVAPORATION RATE (nBuAc = 1): Not applicable.

FREEZING POINT: -101°C (-149.8°F)

BOILING POINT @ 1 atm: -34°C (-29.3°F)

pH: Not applicable.

ODOR THRESHOLD: 0.6 ppm (detection)

APPEARANCE AND COLOR: Chlorine is a greenish-yellow gas/ amber liquid.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor and color of this gas are distinctive warning properties associated with Chlorine.

10. STABILITY and REACTIVITY

STABILITY: Stable.

CONDITIONS TO AVOID: Chlorine does not decompose, but reacts with water to form hydrochloric acid. Chlorine also reacts with carbon monoxide to form phosgene.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Chlorine is a powerful oxidizer. Chlorine is not compatible with most metals, alcohols, hydrocarbons, flammable liquids, flammable solids, flammable gases. Chlorine can react with ammonia-based compound to form toxic chloramine gas.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Extreme heat and contact with incompatible chemicals.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following information is for Chlorine:

Microsomal Mutagenicity Assay (*Salmonella typhimurium*) = 1800 µg/L

Sperm Morphology (mouse, oral) = 20 mg/kg/5 days-continuous

Cytogenic Analysis System test (human, lymphocyte); 20 ppm

LCLo (inhalation, human) = 2530 mg/m³/ 30 minutes; pulmonary effects.

LCLo (inhalation, human) = 500/5 minutes

LC₅₀ (inhalation, rat) = 293 ppm/1 hour

LC₅₀ (inhalation, mouse) = 137 ppm/1 hour

LCLo (inhalation, dog) = 800 ppm/30 minutes

LCLo (inhalation, cat) = 660 ppm/4 hours

LDLo (inhalation, rabbit) = 660 ppm/4 hours

Note: Chlorine produces no known systemic effects. All symptoms and signs result directly or indirectly from the local irritant action of Chlorine.

INHALATION: Exposure of cats to 300 ppm for 1 hour causes severe eye irritation, coughing, breathing difficulties and may cause death. Death rarely occurs in dogs exposed to chlorine concentrations between 280-650 ppm for 30 minutes. Rats and mice exposed at 9-11 ppm chlorine gas for 6 hours/day for 1,3 or 5 days experienced severe damage to tissue lining the nose and respiratory tract. Rabbits exposed repeatedly to concentrations from 0.7-1.7 ppm for up to 9 months experienced weight loss and an increased incidence of respiratory disease.

EYE CONTACT: Chlorine dissolved in water and injected into eyes of rabbits caused severe inflammation and injury to the lens.

SUSPECTED CANCER AGENT: Chlorine is not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is neither considered to be nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Chlorine is severely irritating and corrosive to contaminated tissue.

SENSITIZATION OF PRODUCT: Chlorine is not a known sensitizer with repeated or prolonged contact.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Chlorine on the human reproductive system.

Mutagenicity: Chlorine has been reported to cause mutagenic effects in specific human and animal tissues during experimental studies with exposures at relatively high doses.

Teratogenicity: Chlorine is not expected to cause teratogenic effects in humans.

Mutagenicity: Chlorine has not been reported to cause mutagenic effects in humans.

Embryotoxicity: Chlorine has not been reported to cause embryotoxic effects

Reproductive Toxicity: Chlorine is not expected to cause adverse reproductive effects in humans.

11. TOXICOLOGICAL INFORMATION (Continued)

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Conditions relating to the target organs may be aggravated by overexposures to Chlorine. See Section 3 (Hazard Identification) for information on these conditions.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms, administer oxygen, check teeth for signs of erosion, and conduct lung function tests and chest x-ray. Observe for signs of pulmonary edema. Eliminate overexposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Chlorine.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Chlorine is stable and found naturally in the environment (sources include volcanoes). All work practices should be aimed at eliminating environmental contamination. Additional environmental data for Chlorine are available as follows:

CHLORINE: Water Solubility = 310 cc/ 100 cc water at 10°C. 1.46 g/ 100 cc water at 0°C. 177 cc/ 100 cc water at 30°C. Chlorine hydrolyzes in water to produce hypochlorous acid. There is not potential for bioaccumulation or bioconcentration, due to the toxicity of this substance.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Due to the corrosive nature of Chlorine, animals exposed to Chlorine will experience tissue damage, burns, and may be killed. Oxygen displacement can also be a factor in the toxicity of Chlorine. Plants contaminated with Chlorine may be adversely effected or destroyed. Additional data on effects of Chlorine on plants are available as follows:

(1) Seeds of lettuce were treated with 5 or 10% solutions of available chlorine. 5% solution killed seedlings more quickly because pH fell more quickly, causing higher concentration of hypochlorous acid. (2) exposure to 5% sodium hypochlorite for 120 minutes resulted in abnormal seedlings.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Though Chlorine is only slightly soluble in water, even low concentrations of Chlorine in water is detrimental to aquatic life. If a release of Chlorine occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life. Additional aquatic toxicity data are available for Chlorine as follows:

LC₅₀ (Daphnia magna/water flea) = 0.097 mg/L 30 minutes
LC₅₀ (Daphnia magna/water flea) = 0.063 mg/L 60 minutes
LC₅₀ (*Gambusia affinis*/mosquito fish) = 1.59 mg/L 30 minutes
LC₅₀ (*Gambusia affinis*/mosquito fish) = 0.84 mg/L 60 minutes
TLm (Grass shrimp) = 22 mg/L/96 hours
TLm (Ocean spot) = 0.14 mg/L/24 hours; stress
TLm (Daphnia magna/water flea) = 0.017 mg/L 46 hours
LC₅₀ (*Oncorhynchus kisutch*/Coho salmon) = 208 mg/L 60 minutes
TL₅₀ (*Keratella cochlearis*) = 0.019 mg/L/4 hours

LC₅₀ (Daphnia pulex) = 0.49 mg/L/96 hours
LC₅₀ (*Micropterus salmoides*, largemouth bass) = 0.74 mg/L/24 hours
LC₅₀ (*Salmo gairdnerii*, rainbow trout) = 0.08 mg/L/ 168 hours
TLm (*Carassium auratus*, goldfish) = 0.17 mg/L/24 hours
LC₅₀ (*Lepomis macrochirus*, bluegill sunfish) = 0.44 mg/L/ 96 hours
LC₅₀ (*Pimephales promelas*, fathead minnow) = 0.1 mg/L; 96 hr
LC₅₀ (*Lepomis cyanellus*, green sunfish) = 3.0 mg/L/ 24 hours
Carp: 1.5-0.2 mg/L/12-16 days; 25% killed.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, and local regulations. Return cylinders with residual product to Airgas. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

| | |
|---|-----------------------|
| <u>PROPER SHIPPING NAME:</u> | Chlorine |
| <u>HAZARD CLASS NUMBER and DESCRIPTION:</u> | 2.3 (Poison Gas) |
| <u>UN IDENTIFICATION NUMBER:</u> | UN 1017 |
| <u>PACKING GROUP:</u> | Not Applicable |
| <u>DOT LABEL(S) REQUIRED:</u> | Poison Gas; Corrosive |
| <u>NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000):</u> | 124 |

SPECIAL PROVISION: Chlorine is poisonous by inhalation. Shipments must be properly described as Inhalation Hazard (ZONE B).

14. TRANSPORTATION INFORMATION (Continued)

BULK SHIPMENTS: Follow the requirements of 49 CFR 172.314 and 315.

MARINE POLLUTANT: Chlorine is designated by the Department of Transportation to be a Marine Pollutant (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Refer to the above information for Canadian Shipments. Note: Additional hazard class for Chlorine is: 5.1 (Oxidizing Substance)

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Chlorine is subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

| CHEMICAL NAME | SARA 302 (40 CFR 355, Appendix A) | SARA 304 (40 CFR Table 302.4) | SARA 313 (40 CFR 372.65) |
|---------------|--------------------------------------|----------------------------------|-----------------------------|
| CHLORINE | YES | YES | YES |

U.S. SARA THRESHOLD PLANNING QUANTITY: Chlorine = 100 lb.

U.S. CERCLA REPORTABLE QUANTITIES (RQ): CERCLA RQ and EHS (Extremely Hazardous Substance) RQ for Chlorine = 10 lb.

CANADIAN DSL/NDL INVENTORY STATUS: Chlorine is on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Chlorine is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Chlorine is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity of Chlorine is 2500 lbs. When Chlorine is used for potable water, the finished drinking water should be monitored for disinfection by-products, in accordance with State and US EPA regulations and guidelines. Compliance with the OSHA Process Safety Standard (29 CFR 1910.119) may be applicable to operations involving the use of Chlorine. Under this regulation Chlorine is listed in Appendix A. The Threshold Quantity of Chlorine under this regulation is 1500 lb.

U.S. STATE REGULATORY INFORMATION: Chlorine is covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Chlorine.
California - Permissible Exposure Limits for Chemical Contaminants: Chlorine.
Florida - Substance List: Chlorine.
Illinois - Toxic Substance List: Chlorine.
Kansas - Section 302/313 List: Chlorine.
Massachusetts - Substance List: Chlorine.

Michigan - Critical Materials Register: Chlorine.
Minnesota - List of Hazardous Substances: Chlorine.
Missouri - Employer Information/Toxic Substance List: Chlorine.
New Jersey - Right to Know Hazardous Substance List: Chlorine.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: Chlorine.

Pennsylvania - Hazardous Substance List: Chlorine.
Rhode Island - Hazardous Substance List: Chlorine.
Texas - Hazardous Substance List: Chlorine.
West Virginia - Hazardous Substance List: Chlorine.
Wisconsin - Toxic and Hazardous Substances: Chlorine.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Chlorine is not on the California Proposition 65 lists.

LABELING:

DANGER:

POISONOUS, CORROSIVE LIQUID AND GAS UNDER HIGH PRESSURE.
CAN CAUSE EYE, SKIN AND RESPIRATORY TRACT BURNS.
CAN SUPPORT COMBUSTION.

Do not breath gas.
Store and use with adequate ventilation, and use in closed systems.
Do not get in eyes, on skin or clothing.
Keep oil, grease, and combustibles away.
Use with equipment of compatible materials of construction.
Cylinder temperature should not exceed 52°C (125°F).
Close valve after each use and when empty.
Use in accordance with the Material Safety Data Sheet.

NOTE:

Suck-back into cylinder may cause rupture.
Always use a back flow preventative device in piping.

15. REGULATORY INFORMATION (Continued)

LABELING (continued):



POISON
CALL A PHYSICIAN



FIRST-AID:

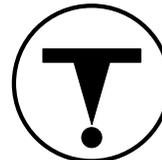
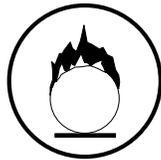
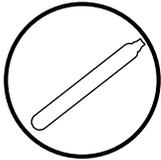
IF INHALED, remove to fresh air. If not breathing, give artificial respiration. (Rescuer may receive chemical burns as a result of giving mouth-to-mouth). If breathing, give oxygen.

IN CASE OF CONTACT, immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. (Discard contaminated shoes).

DO NOT REMOVE THIS PRODUCT LABEL.

CANADIAN WHMIS SYMBOLS:

Class A: Compressed Gas
Class C: Oxidizing Material
Class D1A: Toxic Material/Immediate and Serious Effects
Class D2A: Other Toxic Effects
Class E: Corrosive Material



16. OTHER INFORMATION

PREPARED BY:

Airgas - SAFECOR

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration. **PEL** - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury).

NATIONAL FIRE PROTECTION ASSOCIATION (Continued): Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TD₀**, **LDLo**, and **LD₀**, or **TC**, **TC₀**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations.