



CHLORINE

CHEMICAL PRODUCT

PRODUCT NAME: Chlorine

CHEMICAL NAME: Chlorine

SYMBOL: Cl₂

SYNONYMS: None

[USES]: For general analytic synthetic chemical uses.

INGREDIENT COMPOSITION INFORMATION

CHEMICAL NAME	Mole %	EXPOSURE LIMITS IN AIR					
		ACGIH		OSHA		IDLH	OTHER
		TLV ppm	STE L ppm	PEL ppm	STEL ppm		
Chlorine	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 0.5ppm; DFG MAK: 0.5 ppm
Maximum Impurities	<0.5%						

NE = Not Established

C=Ceiling Limit

HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Chlorine is 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 oxidiser, which can act to initiate and sustain the flammable materials. Chlorine is heavier than air and pockets of this 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 in 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. Exposure to high concentrations of Chlorine gas can lead to symptoms such as coughing, laboured breathing, sorethroat 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 under some circumstances and death. Repeated chlorine overexposures by inhalation can result in emphysema and erosion of teeth. The symptoms associated with specific Chlorine concentrations are as follows:

CONCENTRATION	SYMPTOM OF EXPOSURE
0.06 ppm:	Odor threshold.
3 ppm	Irritation of the eyes and mucous membranes.
15ppm:	Immediate irritation of the throat.
50 ppm:	A dangerous health hazard, even for short periods of time. Prolonged exposure may result in death.
1000 pm:	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, ingestions 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 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 and eyes.

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 your 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).

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

Dry Chemical: YES Halon: YES

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 fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Move fire-exposed cylinders if it can be done without risk to fire-fighters. 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.

ACCIDENTAL RELEASE MEASURES

Foam: YES

Other: Any "ABC" Class

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 large release, clear the affected area, protect people and respond with trained personnel.

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.

Chlorine leaks can be detected by means of an atomizer or squeezebottled 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 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.

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 cylinders, 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 containers 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 a 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, 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 none 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 bounded.

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 suckedback. The rate of gas flow can be increased by improving air circulation about the container or by increasing the temperature of the room if its 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 cylinders output 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.

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

NOTE: Use only DOT or ASME code containers designed for Chlorine storage. Earth-ground and bound all lines and equipment associated with Chlorine. Close valve after its use when empty. Cylinders must not be recharged except by or with the consent of owner.

TANK CAR SHIPMENTS: Tank cars carrying Chlorine should be loaded and unloaded in strict accordance with tank-car manufacturer's recommendation and all established on-site safety procedures. Appropriate personal protective equipment must be used during tank car operations.

All loading and unloading equipment must be inspected, prior to its 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 (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.

EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. A hood with forced ventilation is preferable. Because of 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 (Composition and Information on Ingredients). If respiratory protection is needed, use supplied-air respirations protection during emergency response procedures to releases. The following respiratory protection recommendations for Chlorine are provided for additional information.

CONCENTRATION

CONCENTRATION 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 (PARPR) with Chlorine cartridges; or full-facepiece chemical cartridge respirator with Chlorine cartridge; or a gas mask with an Chlorine canister; or full-facepiece Self-Contained Breathing Apparatus (SCBA), or full-face-piece SAR.

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-facepiece SCBA or positive pressure, full-face piece 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, 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 or any personal protective equipment item can rapidly destroy the equipment, leading to injury and death.

PHYSICAL and CHEMICAL PROPERTIES

ABSOLUTE DENSITY, gas @ 20°C, 101.325 kpa = 2.980 kg/m³

RELATIVE DENSITY, @ 101.325 kpa @ 20°C (Air) = 2.473

SOLUBILITY IN WATER: @ total pressure of 101.325 kpa @ 0°C 4.610 cm³/cm³ water

VAPOR PRESSURE @ 21.1°C 7 bar

EXPANSION RATIO: Not applicable.

SPECIFIC VOLUME @ 21.1°C, 101.325 Kpa = 5.4 ft. ³/lb

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

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.

EVAPORATION RATE (nBuAc=1): Not applicable

TRIPLE POINT = -100.98°C

BOILING POINT @ 101.325 kpa = -34.05°C

pH: Not available

ODOR THRESHOLD: 0.6 ppm (detected)

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.

TOXICOLOGICAL INFORMATION

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 upto 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 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 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.

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 overexposure to Chlorine. See Section 3 (Hazard Identification) for information on these conditions.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms, administer lung function tests and possible chest x-rays. Reduce overexposures.

Delayed pulmonary edema may occur, following overexposure by inhalation

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

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 is 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 this product 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 affected or destroyed. Additional data on effects of Chlorine on plants are available as follows.

10 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, and 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.

DISPOSAL INFORMATION

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed off. Do not dispose locally.

REGULATORY INFORMATION

DANGER POISONOUS, CORROSIVE LIQUID AND GAS UNDER PRESSURE
CAN CAUSE EYE, SKIN AND RESPIRATORY TRACT BURNS
CAN SUPPORT COMBUSTION
Do not breathe gas.

DANGER: 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 only with equipment of compatible material and 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.

FIRST-AID | **IF INHALED**, removed to fresh air. If not breathing, give artificial respiration. (Rescuer may receive chemical burns as a result of giving mouth to mouth).

If breathing is difficult, 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 THE PRODUCT LABEL