



Chlorine (Cl₂)

What It Is

Chlorine Cl₂ is a greenish-yellow gas, 2.5 times heavier than air, normally shipped and stored as liquid in cylinders or tank cars. It may also be formed when some chemicals such as household bleaches are mixed with other chemicals such as ammonia or acids. It is very reactive and corrodes many metals. Moisture increases its reactivity.

Uses and Where Chlorine is Found

Uses

- Purification of water supplies and industrial wastes
- Bleaching agent in paper and textile mills
- Purification of metal in foundries and metallurgical plants
- Chemical processes

Where Chlorine Is Found

- Chlorination areas in water works, sewage plants, and swimming pools
- Foundries, especially those working with aluminum
- Metallurgical plants
- Chemical industries

www.saif.com/employer

- ▶ Safety
- ▶ Safety & health guides

SS-415

last updated

July 2009

© SAIF Corporation

This publication provides practical loss control and safety information to assist you in making your workplace safer. It is not legal advice. SAIF Corporation has made every effort to bring significant Oregon Occupational Safety and Health Administration (OR-OSHA) regulations to your attention. Nonetheless, compliance with OR-OSHA remains your responsibility. You should read and understand all relevant OR-OSHA regulations that apply to your job site(s). You may want to consult with your own attorney regarding aspects of OR-OSHA that may affect you.

Note: The information in this publication is time sensitive. Do not rely upon this document if its publication date is more than three years old. Please check the Employer Guide "Safety" section of our web site at www.saif.com/employer for a more recent, printable copy. You'll also find a variety of other valuable safety information designed to help your business prevent injuries and control costs.

Health Effects and Symptoms of Chlorine Exposure

Chlorine is a potent irritant of the eyes, mucous membrane, skin and respiratory system. Mild mucous membrane irritation may begin to occur at 0.2 parts per million (ppm). Eye irritation can happen at levels as low as 1 to 2 ppm with some studies showing irritation at 7 to 8 ppm; throat irritation at 15 ppm. Death can occur within minutes after exposure of 400 to 1,000 ppm. Chronic exposure of 1 ppm can cause a moderate, but permanent, reduction in pulmonary function.

The range of reported odor threshold is 0.03 to 3.5 ppm; however, because of odor fatigue, the odor does not always serve as an adequate warning of exposure. Some individuals will not notice the odor until it is more than three times the exposure limit.

The location and severity of the respiratory tract involvement are functions of both the concentration and duration of exposure. With significant exposures, acute pulmonary conditions such as tracheal bronchitis, pneumonitis, and pulmonary edema may develop.

Occupational Exposure Limits

The OR-OSHA exposure limit for chlorine is very low due to the extreme irritation hazard and is noted as a ceiling value. The exposure limit of 1 part per million (ppm) should never be exceeded and is an instantaneous limit. Therefore, it is not averaged over an eight-hour period.

The American Conference of Governmental Industrial Hygienists recommends an eight-hour Time Weighted Average (TWA) of 0.5 ppm and 15 minute Short Term Exposure Limit (STEL) of 1 ppm to minimize the potential for eye, mucous membrane and respiratory irritation.

The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) of 0.5 ppm as a ceiling limit not to be exceeded as a 15 minute average. The immediately dangerous to life and health (IDLH) is 10 ppm for chlorine. IDLH is defined as a situation that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment

Testing for Cl₂ Exposure Levels

Air monitoring for chlorine can be done in several ways:

1. Colorimetric tubes (direct reading tubes) can be used to get an estimate of the eight-hour averages and for the excursion limits. It is important to note the limitations of this method. Colorimetric tubes are regarded as +/- 35 percent accurate with measurements down to one half the exposure limit and +/- 25 percent accurate up to five times the exposure limit.

2. Active air sampling using a 25mm closed face silver membrane filter under modified NIOSH method 6011. This technology meets or exceeds OSHA requirements for accuracy. This method can be used to determine both eight hour time weighted average exposures or 15 minute short term exposures.
3. Real time monitoring (portable & fixed) data loggers used for both personal and area monitoring. Monitoring is conducted by either a single gas monitor or area monitor equipped with an electrochemical cell to monitor specifically for chlorine.

Recommendations

Storage

- Cylinders and containers should be stored in a cool, dry, well ventilated and relatively isolated area protected from weather, extreme temperatures and physical damage.
- Cylinders should be stored separately from flammable gases, vapors, and combustible substances such as gasoline, petroleum products, alcohol-based products, ammonia, sulfur, hydrocarbons, and acetylene.
- Cylinders (100 and 150 pound) should be stored upright and secured so they cannot fall. One ton containers should be chocked to prevent rolling.
- Valve outlet caps or hoods should be in place at all times except when containers or cylinders are connected.

Emergency Procedures

- Personnel handling chlorine should be informed of its properties and trained in safe operating procedures.
- If splashed into eyes, flush with copious amounts of water for at least 15 minutes. Lift the upper and lower eyelids frequently to ensure complete washing. Call a physician.
- If splashed on skin or clothing, wash under a safety shower for at least 15 minutes. Remove contaminated clothing if necessary.
- If breathing has slowed or ceased, remove the worker from the exposure and start artificial respiration. Have someone else call a physician.

Protective and Safety Equipment

Clothing

Avoid skin contact with chlorine. Wear protective gloves and chemical-resistant clothing. Keep clothing clean and free of oils and grease.

Eye Protection

Wear splash-proof chemical goggles and a face shield when working with liquid chlorine, unless full face-piece respiratory protection is worn. Gas-proof goggles with a face shield should be worn when there is chlorine gas exposure or risk for a gas exposure.

Respiratory Protection

Respiratory protection should be NIOSH (National Institute for Occupational Safety and Health) approved specifically for chlorine and used in accordance with the OSHA Respiratory Protection Standard, 29 CFR (Code of Federal Regulations) 1910.134. Under routine exposures where the ambient concentration of chlorine exceeds 0.5ppm, an air purifying, full-face respirator equipped with chemical cartridges appropriate for chlorine should be used. For chlorine exposures of unknown concentrations, such as uncontrolled releases, only a pressure-demand SCBA (self-contained breathing apparatus) is appropriate. Respirator use must be limited to individuals who have been adequately trained and fitted for the respirator face piece.

General Hazard Information

Leaks may be detected by using strong ammonia. They need prompt attention because they will increase. Do not use water on a leak because it may worsen it. Use proper respiratory equipment if chlorine is suspected to be present in the air.

Heat lamps or spot heaters should not be used on chlorine cylinders or containers. The fusible safety plug melts at about 160 °F.

Chlorine piping should be dry before being hooked up. Lines should be plugged when disconnected in order to keep moist air out. Do not clean lines with aliphatic solvents (naphtha).

Operators should be properly instructed in operating procedures, testing for leaks, use of protective equipment and emergency procedures.

Additional Requirements

There are a variety of specific requirements dealing with chlorine that go beyond the scope of this guide. Companies are referred to 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals Standard. Chlorine presents a potential for a catastrophic event at or above the threshold quantity of 1,500 pounds according to the List of Highly Hazardous Chemicals, Toxics and Reactives (Mandatory) in 29 CFR 1926.64 Appendix A.

Resources

The Chlorine Institute Inc is a trade association founded in 1924 for companies and organizations dealing with chlorine. They offer a variety of safety information and training materials through their online Product list. Their address is 1300 Wilson Blvd., Rosslyn, VA 22209. Their telephone number and Web sites are (703) 741-5760 and <http://www.chlorineinstitute.org> respectively.

ACGIH[®], Chlorine: TLV[®] Chemical Substances 7th Edition *Documentation*, © 2001

A copy of 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals Standard*, may be obtained from the Oregon Occupational Safety and Health Division (OR-OSHA) by contacting them at:

Address: 350 Winter Street NE, Salem, OR 97301-3882

Telephone: 503.378.3272 or 800.922.2689

Website: <http://www.orosha.org>

Additional information about the recognition, evaluation and control of hazards related to chlorine are available from federal OSHA and the National Institute for Occupational Safety and Health (NIOSH). The web sites are:

Federal OSHA

<http://www.osha.gov/SLTC/healthguidelines/chlorine/recognition.html>

NIOSH

<http://www.cdc.gov/niosh/npg/npgd0115.html>