

Chlorine (Cl₂)

S415 | ©SAIF 07.22

saif
Work. Life. Oregon.

Table of contents

What is it?	3
Uses and where chlorine is found	3
Uses	3
Where chlorine is found	3
Health effects and symptoms of chlorine exposure	3
Occupational exposure limits	3
Testing for chlorine exposure levels	4
Recommendations	4
Storage.....	4
Emergency procedures.....	4
Protective and safety equipment	5
Clothing	5
Eye protection	5
Respiratory protection	5
General hazard information	5
Additional requirements	5
Resources	6

This publication provides practical workplace safety and health information to assist you in making your place of work safer. It is not legal advice. SAIF has made every effort to bring significant Oregon Occupational Safety and Health Administration (Oregon OSHA) regulations to your attention. Nonetheless, compliance with Oregon OSHA remains your responsibility. You should read and understand all relevant Oregon OSHA regulations that apply to your job site(s). You may want to consult with your own attorney regarding aspects of Oregon 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 “Safety and health” section of our web site at saif.com/safetyandhealth 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.

What is it?

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

Health effects and symptoms of chlorine exposure

Cl₂ 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 for Cl₂ gas 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 Oregon OSHA exposure limit for Cl₂ 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 (NIOSH) 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) value is 10 ppm for Cl₂. IDLH is defined as exposure to airborne contaminants that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.

Testing for chlorine exposure levels

Air monitoring for Cl₂ can be done in several ways:

1. Colorimetric tubes or 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 personal sampling pumps and cassettes with filters according to NIOSH method 6011. This technology meets or exceeds OSHA requirements for accuracy and can be used to determine both eight-hour time weighted average exposures or 15-minute short term exposures.
3. Direct reading instruments (portable or fixed) with Cl₂ sensors on a person or in an area. These instruments record Cl₂ levels over longer time periods and can estimate the eight-hour TWA exposures and short term or peak exposure levels.

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 always in place except when containers or cylinders are connected.

Emergency procedures

- Personnel handling Cl₂ 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 Cl₂. 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 Cl₂ unless full face-piece respiratory protection is worn. Gas-proof goggles with a face shield should be worn when there is Cl₂ gas exposure or risk for a gas exposure.

Respiratory protection

Respiratory protection should be NIOSH approved specifically for Cl₂ 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 Cl₂ exceeds 0.5ppm, an air purifying, full-face respirator equipped with chemical cartridges appropriate for Cl₂ should be used. For Cl₂ 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 or direct reading instrumentation. Leaks need prompt attention because they will increase. Do not use water on a leak because it may worsen it. Use proper respiratory equipment if Cl₂ is suspected to be present in the air. Heat lamps or spot heaters should not be used on Cl₂ cylinders or containers. The fusible safety plug melts at about 160°F. Cl₂ piping should be dry before being hooked up. Lines should be plugged when disconnected 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 Cl₂ that go beyond the scope of this guide. Companies are referred to 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals Standard. Cl₂ 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

Copies of the Oregon Occupational Safety and Health Division (Oregon OSHA) regulations are available on the web at:

<https://osha.oregon.gov/Pages/topics/chlorine.aspx>

The Chlorine Institute Inc. is a trade association founded in 1924 for companies and organizations dealing with Cl₂. They offer a variety of safety information and training materials through their online bookstore. Their web site is:

<http://www.chlorineinstitute.org>

OSHA Occupational Chemical Database (Federal OSHA)

<https://www.osha.gov/chemicaldata/chemResult.html?RecNo=650>

Pocket guide to chemical hazards (NIOSH)

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

Fact sheet: Chlorine (CDC)

<https://www.atsdr.cdc.gov/toxfaqs/tfacts172.pdf>

Chlorine: *Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents*, 7th Edition, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 2001