Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Chlorine (MSDS No. P-4580-G)	**Trade Names:** Chlorine
Chemical Name: Chlorine	**Synonyms:** Dichlorine
Chemical Family: Halogen	**Product Grades:** 2.5; 4.0, 4.8 semiconductor process gas; 5.0 research

Telephone: **Emergencies:** 1-800-645-4633* **Company Name:** Praxair, Inc.
CHEMTREC: 1-800-424-9300* 39 Old Ridgebury Road
Routine: 1-800-PRAXAIR Danbury, CT 06810-5113

**Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).*

2. Hazards Identification

EMERGENCY OVERVIEW


DANGER! Poisonous, corrosive liquid and gas under pressure.
Harmful or fatal if inhaled.
Causes eye, skin, and respiratory tract burns.
Can support combustion.
Self-contained breathing apparatus and protective clothing must be worn by rescue workers.
Under ambient conditions; this is a greenish-yellow gas with a pungent, irritating, choking odor.

OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

Effects of a Single (Acute) Overexposure

Inhalation. Overexposure to concentrations moderately above the TLV of 1 ppm irritates the eyes and respiratory tract. Very brief exposure to a concentration of 1000 ppm may be fatal. Acts as an asphyxiant at high concentrations. Inhalation of high concentrations (e.g., greater than 15 ppm) causes choking, coughing, burning of the throat, and severe irritation of the upper respiratory tract; additionally, pulmonary edema, bronchitis, and pneumonitis may result. Lack of oxygen can kill.

Skin Contact. May severely irritate the skin, causing ulceration, chemical burns, and scarring. Repeated exposure may produce dermatitis. With prolonged or widespread contact, the skin may absorb potentially harmful amounts of material.

Swallowing. An unlikely route of exposure; this product is a gas at normal temperature and pressure. May cause chemical burns of the mouth, esophagus, and stomach.

A vertical line in the left margin indicates revised or new material.

Eye Contact. May severely inflame the conjunctiva, injuring the lens and causing corneal opacity and iris atrophy.

Effects of Repeated (Chronic) Overexposure. Repeated exposure may cause progressive lung dysfunction. Exposure may also corrode teeth and may cause a chloracne-like condition.

Other Effects of Overexposure. None known.

Medical Conditions Aggravated by Overexposure. Inhalation may aggravate asthma, inflammatory or fibrotic pulmonary disease, and heart disease. Skin contact may aggravate existing dermatitis.

CARCINOGENICITY: Chlorine is not listed by NTP, OSHA, or IARC.

POTENTIAL ENVIRONMENTAL EFFECTS: None known. For further information, see section 12, Ecological Information.

3. Composition/Information on Ingredients

See section 16 for important information about mixtures.

COMPONENT	CAS NUMBER	CONCENTRATION
Chlorine	7782-50-5	>99%*

**The symbol > means "greater than."*

4. First Aid Measures

INHALATION: Immediately 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 is difficult, qualified personnel may give oxygen. Keep patient warm. Call a physician.

SKIN CONTACT: Avoid breathing vapor. Immediately flush affected areas with plenty of warm water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse; discard contaminated shoes. Call a physician.

SWALLOWING: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

EYE CONTACT: Immediately flush eyes thoroughly with warm water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN: *Victims of overexposure should be kept under medical observation for 24 to 48 hours or 72 hours if exposure was severe. The hazards of this material are due mainly to its severe irritant and corrosive properties on the skin and mucosal surfaces. Injury occurs mainly to the skin and to mucosal surfaces. There is no specific antidote, and treatment should be directed at the control of symptoms and clinical condition. Delayed pulmonary edema may occur.*

Contact the Poison Control Center in your area for additional information on patient management and follow-up.

5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Weak oxidizing agent; may accelerate combustion. Contact with flammable materials may cause fire or explosion.

SUITABLE EXTINGUISHING MEDIA: Oxidizing agent; may accelerate combustion. Use media appropriate for surrounding fire.

PRODUCTS OF COMBUSTION: Not applicable.

PROTECTION OF FIREFIGHTERS: DANGER! Poisonous, corrosive liquid and gas under pressure. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Immediately cool cylinders with water spray from maximum distance; then move them away from fire if without risk. If cylinders are leaking, reduce toxic vapors with water spray or fog. Do not spray water directly on leak; this may cause leak to increase. Reverse flow into cylinders may cause rupture. Shut off leak if without risk. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

Specific Physical and Chemical Hazards. Heat of fire can build pressure in cylinder and cause it to rupture. No part of cylinder should be subjected to a temperature higher than 125ºF (52ºC). Chlorine cylinders are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.) Chlorine may react violently with other materials at temperatures above 483ºF (250.5ºC). (See "Incompatibility Materials," section 10.) Vapors are extremely irritating and may burn skin and eyes on contact.

Protective Equipment and Precautions for Firefighters. Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! Poisonous, corrosive liquid and gas under pressure.

Personal Precautions. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Oxidizing agent; contact with flammable materials may cause fire or explosion. Do not spray water directly on source of flow or leak; this may accelerate flow. Reduce vapors with fog or fine water spray. Reverse flow into cylinder may cause rupture. Shut off flow if without risk. Ventilate area or move cylinder to a well-ventilated area. Prevent runoff from contaminating surrounding environment. Toxic, corrosive vapors may spread from spill. Before entering area, especially a confined area, check atmosphere with an appropriate device.

Environmental Precautions. Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: Do not breathe gas. Do not get liquid or vapor in eyes, on skin, or on clothing. (See section 2.) Have safety showers and eyewash fountains immediately available. Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar)

into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Open valve slowly. If valve is hard to open, discontinue use and contact your supplier. Close valve after each use; keep closed even when empty. For other precautions, see section 16.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. **Oxidizer**. Store away from flammable materials. Keep oil, grease, and combustibles away. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Store only where cylinder temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

RECOMMENDED PUBLICATIONS: For additional information on storage and handling, see NFPA 30 and NFPA 50A, both published by the National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101; 1-800-344-3555; www.nfpa.org. Also see Praxair publication P-14-153, *Guidelines for Handling Gas Cylinders and Containers*. Obtain from your local supplier.

8. Exposure Controls/Personal Protection

COMPONENT	OSHA PEL	ACGIH TLV-TWA (2007)
Chlorine	1 ppm (3 mg/m^3) ceiling*	0.5 ppm; 1 ppm, 15 min STEL

*Ceiling values are not Time-Weighted-Average (TWA).

TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

IDLH = 10 ppm

ENGINEERING CONTROLS:

Local Exhaust. A corrosion-resistant system is acceptable.

Mechanical (General). Inadequate. See SPECIAL.

Special. Use only in a closed system. Corrosion-resistant, forced-draft fume hood is preferred.

Other. See SPECIAL.

PERSONAL PROTECTIVE EQUIPMENT:

Skin Protection. Use neoprene gloves. Metatarsal shoes for cylinder handling and protective clothing where needed. Select per OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

Eye/Face Protection. Wear safety glasses when handling cylinders; wear vapor-proof goggles and a face shield during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.133.

Respiratory Protection. Use an air-supplied respirator or a full-face, positive-pressure, self-contained breathing apparatus. For higher concentrations, use only a full-face, self-contained breathing apparatus operated in the pressure demand mode. Respiratory protection must conform to OSHA 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

9. Physical and Chemical Properties

APPEARANCE:	Greenish-yellow gas
ODOR:	Pungent, irritating, choking
ODOR THRESHOLD:	Not applicable.
PHYSICAL STATE:	Gas at normal temperature and pressure
pH:	Not applicable.
MELTING POINT at 1 atm**:**	-149.85°F (-101.03°C)
BOILING POINT at 1 atm**:**	-29.25°F (-34.03°C)
FLASH POINT (test method)**:**	Not applicable.
EVAPORATION RATE (Butyl Acetate = 1)**:**	High
FLAMMABILITY:	Not applicable.
FLAMMABLE LIMITS IN AIR, % by volume**:**	**LOWER:** Not applicable. **UPPER:** Not applicable.
LIQUID DENSITY at 77ºF (25ºC)	87.27 lb/ft^3 (1.398 g/cm^3)
VAPOR PRESSURE at 68°F (20°C)**:**	100 psia (689.5 kPa)
VAPOR DENSITY at 32°F (0°C) and 1 atm**:**	0.20057 lb/ft^3 (3.2128 kg/m^3)
SPECIFIC GRAVITY (H_2O = 1) at 19.4°F (-7°C)**:**	1.22
SPECIFIC GRAVITY (Air = 1) at 68°F (20°C) and 1 atm**:**	2.473
SOLUBILITY IN WATER at 77°F (25°C)**:**	6269.5 ppm (wt.)
PARTITION COEFFICIENT: n-octanol/water:	Not available.
AUTOIGNITION TEMPERATURE:	Not available.
DECOMPOSITION TEMPERATURE:	Not available.
PERCENT VOLATILES BY VOLUME:	100
MOLECULAR WEIGHT:	70.906
MOLECULAR FORMULA:	Cl_2

10. Stability and Reactivity

CHEMICAL STABILITY: ☐ Unstable ☒ Stable

This material is stable as shipped and stored under normal conditions, i.e., 70°F (21.1°C) so long as exposure to air, water, moisture, and other incompatible materials is avoided.

CONDITIONS TO AVOID: Elevated temperatures; contact with air, moisture, and incompatible materials.

INCOMPATIBLE MATERIALS: Chlorine reacts with most materials, especially flammable materials, other reducing agents, and nearly all metals. At temperatures below 250°F (251°C) certain common metals, e.g., iron, copper, steel, lead, nickel, resist reaction with dry chlorine, but others (e.g., aluminum, arsenic, gold, mercury, tin, titanium) react. Moist chlorine is highly corrosive except to glass, stoneware, porcelain, and certain alloys and only at low pressure. Titanium ignites spontaneously on contact with dry chlorine. Carbon steel ignites in chlorine at temperatures near 483°F (251°C).

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic fumes of chlorides.

POSSIBILITY OF HAZARDOUS REACTIONS: ☒ May Occur ☐ Will Not Occur

Violent reactions may occur at ordinary and especially at elevated temperatures. Hazardous by-products may be produced.

11. Toxicological Information

ACUTE DOSE EFFECTS: LC_{50}, 1 hr, rat = 293 ppm

STUDY RESULTS: Exposures to 30 ppm have been reported to cause intense coughing fits and exposure to 40 to 60 ppm for 30 to 60 minutes or more may cause serious damage. A concentration of 34 to 51 ppm has been reported to be lethal in 1 to 1.5 hours while 14 to 21 ppm has been suggested as being dangerous within 0.5 to 1 hour.

12. Ecological Information

ECOTOXICITY: No known effects.

OTHER ADVERSE EFFECTS: Chlorine does not contain any Class I or Class II ozone-depleting chemicals.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Chlorine

HAZARD CLASS:	2.3	**PACKING GROUP/Zone:**	NA*/B	**IDENTIFICATION NUMBER:**	UN1017	**PRODUCT RQ:**	10 lb (4.54 kg)
SHIPPING LABEL(s):		POISON GAS, CORROSIVE**					
PLACARD (when required):		POISON GAS, CORROSIVE**					

* NA- Not applicable.

***The words in the POISON GAS diamond are INHALATION HAZARD.*

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Additional Marking Requirement: INHALATION HAZARD

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(b)].

MARINE POLLUTANTS: Chlorine is listed as a marine pollutant by DOT.

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): 10 lb (4.54 kg)

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of Extremely Hazardous Substances (EHS) (40 CFR Part 355):

TPQ: 100 lb (45.4 kg)
EHS RQ (40 CFR 355): 10 lb (4.54 kg)

SECTIONS 311/312: Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: Yes	**PRESSURE:** Yes
DELAYED: Yes	**REACTIVITY:** No
	FIRE: Yes

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

Chlorine is subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and 40CFR Part 372.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Chlorine is listed as a regulated substance in quantities of 2500 lb (1134 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: Chlorine is listed on the TSCA inventory.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Chlorine is listed in Appendix A as a highly hazardous chemical in quantities of 1500 lb (680 kg) or greater.

STATE REGULATIONS:

CALIFORNIA: Chlorine is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: Chlorine is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: ***Poisonous, corrosive liquid and gas under pressure.*** **Store and use with adequate ventilation.** Use only in a closed system constructed of corrosion-resistant materials. Use piping and equipment of compatible materials adequately designed to withstand pressures to be encountered. ***Prevent reverse flow.*** Reverse flow into cylinder may cause rupture. Use a backflow prevention device in any line or piping from the cylinder. ***When returning cylinder to supplier, be sure valve is closed;*** then tightly install valve outlet cap or plug. ***Never work on a pressurized system.*** If there is a leak, close the cylinder valve. Blow the system down in a safe and environmentally sound manner in compliance with all federal, state, and local laws; then repair the leak***. Never place a compressed gas cylinder where it may become part of an electrical circuit.***

NOTE: *Prior to using any plastics, confirm their compatibility with chlorine.*

Mixtures. When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

RECOMMENDED EQUIPMENT: In semiconductor process gas and other suitable applications, Praxair recommends the use of engineering controls such as gas cabinet enclosures, automatic gas panels (used to purge systems on cylinder changeout), excess-flow valves throughout the gas distribution system, double containment for the distribution system, and continuous gas monitors.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH	= 4	HEALTH	= 3
FLAMMABILITY	= 0	FLAMMABILITY	= 0
INSTABILITY	= 0	PHYSICAL HAZARD	= 2
SPECIAL	= OX		

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED:	CGA-660 limited-standard for Specialty Gas Industry
PIN-INDEXED YOKE:	Not applicable.
ULTRA-HIGH-INTEGRITY CONNECTION:	CGA-728

Use the proper CGA connections. **DO NOT USE ADAPTERS.** Additional limited-standard connections may apply. See CGA pamphlet V-1 listed below.

Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for this product. Further information can be found in the following materials published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, http://www.cganet.com/Publication.asp.

P-1	*Safe Handling of Compressed Gases in Containers*
V-1	*Compressed Gas Cylinder Valve Inlet and Outlet Connections*
—	*Handbook of Compressed Gases, Fourth Edition*

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

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Printed in USA