

3. Hazards Identification

THRESHOLD LIMIT VALUE: None currently established. Praxair recommends compliance with the OSHA and ACGIH (1997) limits of 5 ppm (ceiling) for hydrogen chloride, formed by the hydrolysis of silicon tetrachloride. NOTE: Ceiling limits are not Time Weighted Average (TWA).

EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION—Low concentrations will irritate the eyes and respiratory tract, experienced as eye discomfort, cough, excess sputum, and chest discomfort. Exposure to higher concentrations is likely to result in inhalation of enough harmful material to cause potentially lethal lung injury.

SKIN CONTACT—Silicon Tetrachloride is corrosive and causes chemical burns. Prolonged or widespread skin contact may result in the absorption of potentially harmful amounts of material.

SWALLOWING—Highly to seriously toxic. May cause severe burns of the mouth, throat, esophagus, and stomach, with severe abdominal and chest pain. Nausea, vomiting, diarrhea, dizziness, drowsiness, faintness, circulatory collapse, and coma will occur.

EYE CONTACT—Vapor severely irritates the eyes causing pain, excess lachrymation (tears), closure of the eyelids, marked excess redness, and swelling of the conjunctiva. High concentrations of hydrogen chloride vapor, if formed, could injure the cornea. Splash contamination may cause severe conjunctivitis, seen as marked excess redness and swelling of the conjunctiva, discharge, iritis, and severe corneal injury, which if untreated, could result in permanent blindness.

EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE: Prolonged or repeated exposure to hydrogen chloride vapor may discolor and erode the teeth, ulcerate the nasal mucosa, and cause the nose and gums to bleed.

OTHER EFFECTS OF OVEREXPOSURE: None known.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Inhalation may aggravate asthma and inflammatory or fibrotic pulmonary disease. Skin irritation may aggravate an existing dermatitis.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: None known.

CARCINOGENICITY: Silicon Tetrachloride is not listed by NTP, OSHA, and IARC.

4. First Aid Measures

INHALATION: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

SKIN CONTACT: Avoid breathing vapor. Remove contaminated clothing and flush skin with water. Call a physician. Wash clothing before reuse.

SWALLOWING: Do not induce vomiting. If patient is conscious, give large quantities of milk or water. Call a physician and get medical attention without delay.

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: *The primary hazard from silicon tetrachloride results from formation of hydrochloric acid upon contact with moisture. Vapors may produce delayed corneal and pulmonary*

injury. Delayed onset pulmonary edema may occur upon massive overexposure, and secondary infection may occur in the chemically inflamed respiratory tract. Cases of overexposure should be kept under observation. Mediastinitis from esophageal perforation, or peritonitis from gastric perforation may occur upon ingestion. Aspirated silicon tetrachloride can produce severe lung damage. Due to the severely irritant nature of this material, gastric lavage should be carried out with caution.

5. Fire Fighting Measures

FLASH POINT (test method)	Not applicable	AUTOIGNITION TEMPERATURE	Not applicable
FLAMMABLE LIMITS IN AIR, % by volume	LOWER	Not applicable	UPPER Not applicable

EXTINGUISHING MEDIA: See Special Firefighting Procedures below..

SPECIAL FIRE FIGHTING PROCEDURES:

DANGER! Corrosive liquid and gas under pressure (see section 3). Reacts vigorously with water to form hydrogen chloride fumes. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Small fires close to stored silicon tetrachloride may be extinguished using carbon dioxide, dry chemical extinguishers, or dry sand, properly applied. In large fires where silicon tetrachloride leakage may occur, water spray may be used if applied in quantities sufficient to absorb the heat of reaction with silicon tetrachloride and knock down the hydrogen chloride fumes. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Reaction of silicon tetrachloride with water or its decomposition in the presence of heat and air, can form dense white clouds of silica particles and hydrogen chloride. These vapors are extremely irritating and may burn skin and eyes on contact. Fire fighters should be protected by full-face, air-supplied mask and full protective clothing. Heat of fire can build pressure in cylinder and cause it to rupture. Silicon Tetrachloride cylinders may be equipped with a pressure relief device. No part of cylinder should be subjected to a temperature higher than 125°F (52°C).

HAZARDOUS COMBUSTION PRODUCTS: See section 10.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! Corrosive liquid and gas under pressure (see section 3). Reacts vigorously with water to form hydrogen chloride fumes. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and full protective clothing. Reduce vapors with large amounts of water spray. Shut off flow if without risk. Ventilate area or move cylinder to a well-ventilated area. Contain spills in protected areas; prevent runoff from exposing personnel to liquid and vapors and contaminating the surrounding environment. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state and local regulations. (See section 16.) If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. 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 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.

NOTE: *If kept dry and uncontaminated, Silicon tetrachloride is considered stable in prolonged storage. Avoid all contact with water including moisture in the air.*

PRECAUTIONS TO BE TAKEN IN HANDLING: 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. For other precautions in using silicon tetrachloride, see section 16.

For additional information on storage and handling, refer to Compressed Gas Association (CGA) pamphlet P-1, "Safe Handling of Compressed Gases in Containers," available from the CGA. Refer to section 16 for the address and phone number along with a list of other available publications.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST—Use a corrosion-resistant and explosion-proof local exhaust ventilation system with sufficient air flow velocity to maintain concentration below the TLV in the worker's breathing zone.

MECHANICAL (general)—Not recommended as a primary ventilation system to control worker's exposure.

SPECIAL—A corrosion-resistant, canopy-type forced-draft fume hood may be more desirable for certain applications.

OTHER—None.

RESPIRATORY PROTECTION: Select per OSHA 29 CFR 1910.134 and ANSI Z88.2. Use air-supplied respirators for concentrations up to 10 times the applicable permissible exposure limit. For higher concentrations, a full-face, self-contained breathing apparatus operated in the pressure demand mode is required.

PROTECTIVE GLOVES: Neoprene.

EYE PROTECTION: Wear safety glasses when handling cylinders; vapor-proof goggles or face mask where needed. Select per OSHA 29 CFR 1910.133.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for cylinder handling. Protective clothing to include a full face shield and apron where needed. Select per OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

9. Physical and Chemical Properties

MOLECULAR WEIGHT: 169.89	EXPANSION RATIO: Not applicable
SPECIFIC GRAVITY (H₂O=1): At 70°F (21.1°C) and 1 atm: 1.483	SOLUBILITY IN WATER: Reacts violently
LIQUID DENSITY: At 70°F (21.1°C) and 1 atm: 92.76 lb/ft ³ (1485.87 kg/m ³)	VAPOR PRESSURE: AT 70°F (21.1°C): 3.89 psia (26.82 kPa, abs)

PERCENT VOLATILES BY VOLUME: 100	EVAPORATION RATE (Butyl Acetate=1): 20 (estimated)
BOILING POINT (1 atm): 134.33°F (56.85°C)	pH: Not applicable
FREEZING POINT (1 atm): -94°F (-70°C)	
APPEARANCE, ODOR, AND STATE: Clear liquid at normal temperature and pressure; pungent, suffocating odor.	

10. Stability and Reactivity

STABILITY:	Unstable	Stable	X
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INCOMPATIBILITY (materials to avoid): Water, bases, organic materials, potassium and sodium. Reacts very rapidly with alcohols, primary and secondary amines, ammonia and other compounds containing active hydrogen atoms.

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition or burning may produce hydrochloric acid and silicon oxides. Reacts vigorously with water to form hydrogen chloride fumes.

HAZARDOUS POLYMERIZATION:	May Occur	Will Not Occur	X
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CONDITIONS TO AVOID: Silicon Tetrachloride is not a monomer in the usual sense and, therefore, will not condense or polymerize under normal conditions of handling or storage

11. Toxicological Information

No information available.

12. Ecological Information

Silicon Tetrachloride does not contain any Class I or Class II ozone-depleting chemicals. Silicon Tetrachloride is not listed as a marine pollutant by DOT.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Keep waste from contaminating surrounding environment. Keep personnel away. Do not dispose of unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Silicon tetrachloride	HAZARD CLASS: 8
IDENTIFICATION NUMBER: UN 1818	PRODUCT RQ: None
SHIPPING LABEL(s): CORROSIVE	PLACARD (When required): CORROSIVE

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.

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)].

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): None

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 (40 CFR Part 355):

Threshold Planning Quantity (TPQ): None

Extremely Hazardous Substances (40 CFR 355): None

- **SECTIONS 311/312:** Require submission of Material Safety Data Sheets (MSDSs) and chemical inventory reporting with identification of EPA hazard categories. The hazard categories for this products are as follows:

IMMEDIATE: Yes

PRESSURE: No

DELAYED: Yes

REACTIVITY: Yes

FIRE: No

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

Silicon Tetrachloride does not require reporting under Section 313.

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.

Silicon Tetrachloride is not listed.

TSCA: Toxic Substances Control Act: Silicon Tetrachloride 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.

Silicon Tetrachloride is not listed in Appendix A as a highly hazardous chemical.

STATE REGULATIONS:

CALIFORNIA: This product is not listed by California under the Safe Drinking Water Toxic Enforcement Act of 1986 (Proposition 65).

PENNSYLVANIA: This product 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: *Corrosive liquid and gas under pressure.* Do not breathe vapor. Do not get vapor or liquid in eyes, on skin, or on clothing. (See section 3.) Have safety showers and eyewash fountains immediately available. Use piping and equipment adequately designed to withstand pressures to be encountered. Store and use with adequate ventilation at all times.

NOTE: *Provided moisture is excluded, steel is normally an acceptable material of construction for storage tanks, piping and other equipment in silicon tetrachloride service. Stainless steel and aluminum are not suitable.*

Gas reacts with trace amounts of water to form highly corrosive acid. Use only in a closed system constructed of corrosion-resistant materials and kept scrupulously dry. **Prevent reverse flow.** Reverse flow into cylinder may cause rupture. Use a check valve or other protective device in any line or piping from the cylinder. **Purge system with a dry, inert gas before and after use.** Close cylinder valve after each use; keep closed even when empty. Be sure to read and understand all labels and instructions supplied with all containers of this product. **Never work on a pressurized system.** If there is a leak, close the cylinder valve. Blow the system down in an environmentally safe manner in compliance with all federal, state, and local laws, then repair the leak. **Never ground a compressed gas cylinder or allow it to become part of an electrical circuit.**

NOTE: *Silicon tetrachloride vapors react with moisture in air to produce dense white clouds of silica and hydrogen chloride. This product should be confined within enclosed equipment and should not be vented in to air. Where venting is necessary, silicon tetrachloride should be vented through a scrubber system equipped to handle hydrogen chloride.*

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.

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.

HAZARD RATING SYSTEMS:**NFPA RATINGS:**

HEALTH = 3
FLAMMABILITY = 0
REACTIVITY = 2
SPECIAL W

HMIS RATINGS:

HEALTH = 2
FLAMMABILITY = 0
REACTIVITY = 2

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: No standard CGA assignment (CGA-330 may be encountered)

PIN-INDEXED YOKE: Not applicable

ULTRA-HIGH-INTEGRITY CONNECTION: CGA-636

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 referenced on the label for this product; you may also obtain copies by calling 1-800-PRAXAIR. Further information about silicon tetrachloride can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 1725 Jefferson Davis Highway, Arlington, VA 22202-4102, Telephone (703) 412-0900.

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

Praxair asks users of this product to study this Material Safety Data Sheet (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 on 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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