

Material Safety Data Sheet



Dichlorosilane

1. Product and company identification

Product name	: Dichlorosilane
Synonym	: DCS
Trade name	: Praxair Chlorosilane A-199
Material uses	:
Manufacturer	: Praxair Canada Inc. 1 City Centre Drive Suite 1200 Mississauga, ON L5B 1M2
MSDS #	: E-4587-D
Validation date	: Oct 15, 2013.
Print date	: Oct 15, 2013.
<u>In case of emergency</u>	: Emergencies: * 1-800-363-0042 *Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier or Praxair sales representative.
Product type	: Gas.

2. Hazards identification

Physical state	: Gas.
Odor	: Irritating, Chocking, (Strong).
Emergency overview	: DANGER! Toxic, flammable, corrosive, high pressure liquid & gas. May be fatal if inhaled. Causes eye, skin and respiratory tract burns. Water can cause violent reaction. Symptoms may be delayed. Self-contained breathing apparatus may be required by rescue workers. Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode. Harmful by inhalation. Do not puncture or incinerate container. Do not breathe gas. Avoid contact with eyes, skin and clothing. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use.
Routes of entry	: Inhalation
<u>Potential acute health effects</u>	
Inhalation	: Low vapour concentrations will irritate the nose, throat and chest, causing discomfort or pain with coughing, excess sputum, runny nose and difficulty with breathing. Higher concentrations may result in the inhalation of harmful and possibly lethal, amounts of materials. The nasal passages, larynx and lungs may be injured.
Ingestion	: An unlikely route of exposure. This product is a gas at normal temperature and pressure. May cause burns of the mouth, oesophagus and stomach. There may be pain in the mouth, throat, chest, and abdomen and possible swelling of the tissues in the mouth and throat. Effects may include nausea, vomiting, diarrhea, dizziness, drowsiness, faintness, weakness, thirst, circulatory collapse, and loss of consciousness.
Skin	: Brief contact will cause itching or discomfort, with the development of local redness and possibly swelling. Sustained contact will cause pain, local redness, ulceration and possible bleeding into the inflamed site. Prolonged or widespread skin contact may result in absorption or potentially harmful amounts of material.
Eyes	: Vapor will cause discomfort or pain in the eye, with excess tear production and blinking and excess redness and possibly swelling of the conjunctiva. If high concentrations of hydrogen chloride are formed, then injury to the cornea may develop. Splashes of liquid in the eye will cause pain, excess tear production and blinking, and marked excess redness and swelling of the conjunctiva. Severe corneal injury may occur, which if not adequately treated, could permanently impair vision.

2. Hazards identification

Potential chronic health effects

- Chronic effects** : Classified A4 (not classifiable for human or animal) by ACGIH, 3 (not classifiable for human) by IARC [Hydrogen chloride].
Prolonged or repeated exposure to hydrogen chloride vapour may discolour and erode the teeth, ulcerate the nasal mucosa, and cause nose and gums to bleed.
- Carcinogenicity** : Not listed as carcinogen by OSHA, NTP or IARC.
- Mutagenicity** : No known significant effects or critical hazards.
- Teratogenicity** : No known significant effects or critical hazards.
- Developmental effects** : No known significant effects or critical hazards.
- Fertility effects** : No known significant effects or critical hazards.
- Target organs** : Contains material which may cause damage to the following organs: upper respiratory tract, skin, eyes.

Over-exposure signs/symptoms

- Inhalation** : No specific data.
- Ingestion** : No specific data.
- Skin** : No specific data.
- Eyes** : No specific data.

Medical conditions aggravated by over-exposure : Inhalation may aggravate asthma and inflammatory or fibrotic pulmonary disease. Because of its irritating properties, this material may aggravate an existing dermatitis.

See toxicological information (section 11)

3. Composition/information on ingredients

<u>Name</u>	<u>CAS number</u>	<u>%</u>
dichlorosilane	4109-96-0	99.9999
Hydrogen chloride	7647-01-0	0.0001

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First aid measures

- Eye contact** : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.
- Skin contact** : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.
- Inhalation** : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.
- Ingestion** : As this product is a gas, refer to the inhalation section.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.
- Notes to physician** : Part of the effects from overexposure to dichlorosilane are due to liberation of hydrogen chloride.
- Dichlorosilane is highly irritant and corrosive to mucosae.
 - Swallowed dichlorosilane may produce ulceration and possible perforation in the upper alimentary tract. Mediastinitis or peritonitis and the complication thereof may develop.

4. First aid measures

- With massive overexposure to the vapour, delayed onset pulmonary edema may develop. Secondary infection may develop in the inflamed respiratory tract. Individuals having significant overexposure to the vapour should be kept under observation.

- Aspirated materials may produce lung injury. Emesis should not be induced mechanically or pharmacologically. If it is considered necessary to evacuate the stomach contents, then this should be undertaken by means least likely to result in aspiration, e.g., in the presence of airway intubation. Caution should be taken to avoid perforation of an acutely inflamed or ulcerated area of the alimentary tract.

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

5. Fire-fighting measures

Flammability of the product : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Extinguishing media

Suitable : Use an extinguishing agent suitable for the surrounding fire.

Not suitable : None known.

Special exposure hazards : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
halogenated compounds
metal oxide/oxides

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Special remarks on fire hazards : Exposure to heat from a fire or from the waterdichlorosilane reaction can cause the dichlorosilane to autoignite. The acidic decomposition products formed by burning dichlorosilane from leaks may rapidly attack the metal at the leak area, especially if the metal is hot. Use proper bonding and grounding during liquid transfer as described in National Fire Protection Association document NFPA 77.

Special remarks on explosion hazards : Flammable gas. Forms explosive mixtures with air and oxidizing agents. Container may rupture due to heat of fire. Do not extinguish flames due to possibility of explosive re-ignition. Vapours form from this product and may travel or be moved by air currents an ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharges, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with approved device. No part of a container should be subjected to temperature higher than 52 C. Most containers are provided with a pressure relief device designed to vent contents when they are exposed to elevated temperature.

6. Accidental release measures

Personal precautions : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see section 8).

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods for cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk.

6. Accidental release measures

- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7. Handling and storage

- Handling** : Put on appropriate personal protective equipment (see section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Contains gas under pressure. Do not get in eyes or on skin or clothing. Do not breathe gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container.
- Storage** : Store in accordance with local regulations. Store in a segregated and approved area. Store in a dry, cool and well-ventilated area, away from incompatible materials (see section 10). Keep container tightly closed and sealed until ready for use. For full details and requirements, see NFPA 50A, published by the National Fire Protection Association.

8. Exposure controls/personal protection

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredient	List name	ppm	mg/m ³	Other	ppm	mg/m ³	Other	ppm	mg/m ³	Other	Notations
No exposure limit value known.											

Consult local authorities for acceptable exposure limits.

- Recommended monitoring procedures** : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.
- Engineering measures** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.
- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
- Personal protection**
- Respiratory** : 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 is required.
- Select in accordance with provincial regulations, local bylaws or guidelines. Selection should also be based on the current CSA standard Z94.4, "Selection Care and Use of Respirators". Respirators should also be approved by NIOSH and MSHA.
- Hands** : Wear neoprene work gloves when handling cylinders.
- Eyes** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
- Skin** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

8. Exposure controls/personal protection

Other protection	: Metatarsal shoes for cylinder handling. Protective clothing where needed. Cuffless trousers should be worn outside the shoes. Select in accordance with the current CSA standard Z195, "Protective Foot Wear", and any provincial regulations, local bylaws or guidelines.
Personal protective equipment (Pictograms)	: Not available.

9. Physical and chemical properties

Physical state	: Gas.
Flash point	: Closed Cup -52.2 C (-62 F) (Tag)
Burning time	: Not applicable.
Burning rate	: Not applicable.
Auto-ignition temperature	: 44 C (111.2 F)
Flammable limits	: Not available.
Color	: Colorless.
Odor	: Irritating, Chocking, (Strong).
Taste	: Not available.
Molecular weight	: 101 g/mole
Molecular formula	: Not applicable.
pH	: Not available.
Boiling/condensation point	: 8.2 C (46.8 F)
Melting/freezing point	: -122 C (-187.6 F)
Critical temperature	: Not available.
Relative density	: 3.48
Vapor pressure	: Not available.
Vapor density	: Not applicable
Volatility	: Not available.
Odor threshold	: Not available.
Evaporation rate	: Not available.
Viscosity	: Not available.
Ionicity (in water)	: Not available.
Dispersibility properties	: Not available.
Solubility	: Insoluble in cold water.
Physical/chemical properties comments	: Not available.
COEFFICIENT OF WATER/OIL DISTRIBUTION:	: Not applicable

10. Stability and reactivity

Chemical stability	: Not available
Conditions to avoid	: No specific data.
Materials to avoid	: At room temperature, this product may explode on contact with nitrates; other oxidizing agents may cause similar behaviour. It reacts violently with water. It reacts rapidly (exothermically) with alcohols, primary and secondary amines, ammonia, and other compounds containing active hydrogen atoms. It will react violently with the water in aqueous acid solutions. When it reacts with moisture in the air, it produces dense white clouds of silica and large volumes of hydrogen chloride. Hydrogen, which can pose fire and explosion hazards, may also be evolved. The solid hydrolysis products are also reported to be flammable. Dichlorosilane may redistribute under the influence of heat or catalysts, such as amines, rust, or aluminium chloride, to form mixtures of silane, monochlorosilane, trichlorosilane, and silicon tetrachloride. These mixtures may be pyrophoric (may ignite spontaneously when exposed to air or oxygen).

10. Stability and reactivity

Hazardous decomposition products : Burning can produce chlorine, hydrogen chloride, hydrogen and oxides of silicon. Acute overexposure to the products of combustion may irritate the respiratory tract. Fires resulting from chlorosilane leaks in steel equipment present a special hazard. The acidic decomposition products may rapidly attack the steel at the leak area, especially if the steel is hot.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

11. Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
dichlorosilane	LC50 Inhalation Vapor	Rat	314 ppm	1 hours

Conclusion/Summary : Not available.

Chronic toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Not available.				

Conclusion/Summary : Not available.

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Not available.					

Sensitizer

Product/ingredient name	Route of exposure	Species	Result
Not available.			

Conclusion/Summary : Not available.

Carcinogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Not available.				

Conclusion/Summary : Not available.

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Not available.						

Mutagenicity

Product/ingredient name	Test	Experiment	Result
Not available.			

Conclusion/Summary : Not available.

Teratogenicity

Product/ingredient name	Result	Species	Dose	Exposure
Not available.				

Conclusion/Summary : Not available.

Reproductive toxicity

Product/ingredient name	Maternal toxicity	Fertility	Development toxin	Species	Dose	Exposure
Not available.						

Conclusion/Summary : Not available.

Synergistic products : Not available.

12. Ecological information

Ecotoxicity : No known significant effects or critical hazards.

Aquatic ecotoxicity

Product/ingredient name	Test	Result	Species	Exposure
Not available.				

Conclusion/Summary : Not available.

Persistence/degradability

Product/ingredient name	Test	Result	Dose	Inoculum
Not available.				

Conclusion/Summary : Not available.

Octanol/water partition coefficient : Not available.

Bioconcentration factor : Not available.

Mobility : Not available.

Toxicity of the products of biodegradation : Not available.

Other adverse effects : No known significant effects or critical hazards.

13. Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Do not puncture or incinerate container. Empty pressure vessels should be returned to the supplier.


Waste stream : Not available.

RCRA classification : Not available.

Disposal should be in accordance with applicable regional, national, and local laws and regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14. Transport information

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label	Additional information
TDG Classification	2189	Dichlorosilane	2.3 (2.1, 8)	-		PRODUCT REPORTABLE QUANTITY (PRQ): Any accidental release in a quantity that could pose a danger to public safety or any sustained release of 10 minutes or more.

PG* : Packing group

SPECIAL SHIPPING INFORMATION:

Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, non-ventilated compartment of a vehicle can present serious safety hazards.

15. Regulatory information

- United States inventory (TSCA 8b)** : All components are listed or exempted.
- WHMIS (Canada)** : Class A: Compressed gas.
Class B-1: Flammable gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).
Class E: Corrosive material
Class F: Dangerously reactive material.
- Canadian lists** : **CEPA Toxic substances**: None of the components are listed.
Canadian ARET: None of the components are listed.
Canadian NPRI: None of the components are listed.
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.
- Canada inventory** : Not determined.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

International regulations

- International lists** : **Australia inventory (AICS)**: Not determined.
China inventory (IECSC): Not determined.
Japan inventory: Not determined.
Korea inventory: Not determined.
New Zealand Inventory of Chemicals (NZIoC): Not determined.
Philippines inventory (PICCS): Not determined.
- Chemical Weapons Convention List Schedule I Chemicals** : Not listed
- Chemical Weapons Convention List Schedule II Chemicals** : Not listed
- Chemical Weapons Convention List Schedule III Chemicals** : Not listed

16. Other information

- Label requirements** : Toxic, flammable, corrosive, high pressure liquid & gas. May be fatal if inhaled. Causes eye, skin and respiratory tract burns. Water can cause violent reaction. Symptoms may be delayed. Self-contained breathing apparatus may be required by rescue workers.

Hazardous Material Information System (U.S.A.) :

Health	3
Flammability	4
Physical hazards	2

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

References :

16. Other information

Other special considerations : Not available.

Date of printing : Oct 15, 2013.

Date of issue : Oct 15, 2013.

Date of previous issue : No previous validation.

Version : 0.03

✓ Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: CGA-678

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 pamphlets V-1 and V-7 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 about this product can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, Fax (703) 961-1831, website: www.cganet.com.

MIXTURES:

When two or more gases, or liquefied gases are mixed, their hazardous properties may combine to 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 make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

For more in-depth information for each component, refer to the pure product MSDS.

The information contained in this MSDS is generated from technical sources using the Chemmate Mixture MSDS system and the pure-product MSDS for each component. These mixtures are not tested as a whole for chemical, physical, or health effects.

The opinions expressed herein are those of qualified experts within Praxair Canada 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 Canada Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair Canada Inc. requests the users of this product to study this Material Data Sheet (MSDS) and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify its employees, agents and contractors of the information on this MSDS and any product hazards and safety information, (2) furnish this same information to each of its customers for the product, and (3) request such customers to notify their employees and customers for the product of the same product hazards and safety information.

Praxair and the *Flowing Airstream* design are trademarks of
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16. Other information



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