

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key: **EXTREME** **HIGH** **MODERATE** **LOW**

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

Trichloro(3,3,3-trifluoropropyl)silane

STATEMENT OF HAZARDOUS NATURE

CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA



SUPPLIER

Company: Santa Cruz Biotechnology, Inc.

Address:

2145 Delaware Ave

Santa Cruz, CA 95060

Telephone: 800.457.3801 or 831.457.3800

Emergency Tel: CHEMWATCH: From within the US and Canada:
877-715-9305

Emergency Tel: From outside the US and Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

PRODUCT USE

Silylating agent .

SYNONYMS

C3-H4-Cl3-F3-Si, CF3CH2CH2SiCl3, "trichloro(3, 3, 3-trifluoropropyl)silane", "silylating agent"

Section 2 - HAZARDS IDENTIFICATION

CANADIAN WHMIS SYMBOLS



EMERGENCY OVERVIEW

RISK

Reacts violently with water.

Causes burns.

Risk of serious damage to eyes.

Highly flammable.

POTENTIAL HEALTH EFFECTS

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ACUTE HEALTH EFFECTS

SWALLOWED

- The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.
- Ingestion of acidic corrosives may produce burns around and in the mouth, the throat and esophagus. Immediate pain and difficulties in swallowing and speaking may also be evident. Swelling of the epiglottis may make it difficult to breathe which may result in suffocation. More severe exposure may result in vomiting blood and thick mucus, shock, abnormally low blood pressure, fluctuating pulse, shallow respiration and clammy skin, inflammation of stomach wall, and rupture of esophageal tissue. Untreated shock may eventually result in kidney failure. Severe cases may result in perforation of the stomach and abdominal cavity with consequent infection, rigidity and fever. There may be severe narrowing of the esophageal or pyloric sphincters; this may occur immediately or after a delay of weeks to years. There may be coma and convulsions, followed by death due to infection of the abdominal cavity, kidneys or lungs.
- Ingestion of liquid chlorosilanes may cause severe internal injury or death. The chlorosilanes all react with moisture in the air or water to produce hydrogen chloride, the principal reaction product that can cause acute injury to any body tissue contacted. Ingestion of liquid chlorosilane could cause severe corrosive burns of the mouth, esophagus and stomach, potentially resulting in perforated viscus with subsequent chemical pleuritis, mediastinitis and peritonitis.
- The material has NOT been classified as "harmful by ingestion". This is because of the lack of corroborating animal or human evidence. The material may still be damaging to the health of the individual, following ingestion, especially where pre-existing organ (e.g. liver, kidney) damage is evident. Present definitions of harmful or toxic substances are generally based on doses producing mortality (death) rather than those producing morbidity (disease, ill-health). Gastrointestinal tract discomfort may produce nausea and vomiting. In an occupational setting however, unintentional ingestion is not thought to be cause for concern.

EYE

- The material can produce chemical burns to the eye following direct contact. Vapors or mists may be extremely irritating.
- If applied to the eyes, this material causes severe eye damage.
- Direct eye contact with acid corrosives may produce pain, tears, sensitivity to light and burns. Mild burns of the epithelia generally recover rapidly and completely. Severe burns produce long-lasting and possibly irreversible damage. The appearance of the burn may not be apparent for several weeks after the initial contact. The cornea may ultimately become deeply opaque resulting in blindness.
- Direct contact of chlorosilane liquid with the eyes causes severe corrosive damage that may result in total loss of sight. Vapour exposure to the eyes may result in significant irritation up to severe chemical burns that may result in total loss of sight.
- Irritation of the eyes may produce a heavy secretion of tears (lachrymation).

SKIN

- The material can produce chemical burns following direct contact with the skin.
- Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.
- Skin contact is not thought to have harmful health effects, however the material may still produce health damage following entry through wounds, lesions or abrasions.
- Skin contact with either chlorosilane vapour or liquid can cause burns varying in severity from first to third degree, depending on concentration and length of exposure.
- Open cuts, abraded or irritated skin should not be exposed to this material.
- Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.
- Solution of material in moisture on the skin, or perspiration, may markedly increase skin corrosion and accelerate tissue destruction.

INHALED

- The material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.
- Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage. There may be dizziness, headache, nausea and weakness. Swelling of the lungs can occur, either immediately or after a delay; symptoms of this include chest tightness, shortness of breath, frothy phlegm and cyanosis. Lack of oxygen can cause death hours after onset.
- Inhalation of chlorosilane vapours or hydrochloric acid vapours or mist may cause damage of the respiratory tract. Chlorosilane injury from inhalation primarily affects the upper respiratory tract, causing inflammation, oedema and corrosive burns of the oral, nasal and pharyngeal mucosa and the upper airways.
- The material has NOT been classified as "harmful by inhalation". This is because of the lack of corroborating animal or human evidence. In the absence of such evidence, care should nevertheless be taken to ensure exposure is kept to a minimum and that suitable control measures be used, in an occupational setting to control vapors, fumes and aerosols.
- Inhalation of quantities of liquid mist may be extremely hazardous, even lethal due to spasm, extreme irritation of larynx and bronchi, chemical pneumonitis and pulmonary edema.
- Hydrogen chloride (HCl) vapour or fumes present a hazard from a single acute exposure. Exposures of 1300 to 2000 ppm have been lethal to humans in a few minutes. Inhalation of HCl may cause choking, coughing, burning sensation and may cause ulceration of the nose, throat and larynx. Fluid on the lungs followed by generalised lung damage may follow. Breathing of HCl vapour may aggravate asthma and inflammatory or fibrotic pulmonary disease. High concentrations cause necrosis of the tracheal and bronchial epithelium, pulmonary oedema, atelectasis and emphysema and damage to the pulmonary blood vessels and liver.

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sc-237273

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Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
------------------------	---------	------	----------	-----

CHRONIC HEALTH EFFECTS

■ Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and or ulceration of mouth lining. Irritation of airways to lung, with cough, and inflammation of lung tissue often occurs. Chronic exposure may inflame the skin or conjunctiva. Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems. Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.

Chronic minor exposure to hydrogen chloride (HCl) vapour or fume may cause discolouration or erosion of the teeth, bleeding of the nose and gums; and ulceration of the nasal mucous membranes.

Repeated exposures of animals to concentrations of about 34 ppm HCl produced no immediate toxic effects.

Workers exposed to hydrochloric acid suffered from gastritis and a number of cases of chronic bronchitis have also been reported.

Repeated or prolonged exposure to dilute solutions of HCl may cause dermatitis.

Repeated contact with dilute solutions of chlorosilanes or hydrochloric acid mists will cause irritant dermatitis. Repeated inhalation of the mist will cause an inflammation of the upper and lower respiratory tract.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

HAZARD RATINGS

		Min	Max
Flammability:	3		
Toxicity:	0		
Body Contact:	3		
Reactivity:	2		
Chronic:	2		

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4



NAME	CAS RN	%
3,3,3-trifluoropropyltrichlorosilane	592-09-6	>98
hydrolyses in water to produce		
hydrogen chloride	7647-01-0	

Section 4 - FIRST AID MEASURES

SWALLOWED

-
- For advice, contact a Poisons Information Center or a doctor at once.
- Urgent hospital treatment is likely to be needed.
- If swallowed do NOT induce vomiting.
- If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
- Observe the patient carefully.
- Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
- Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
- Transport to hospital or doctor without delay.

EYE

- If this product comes in contact with the eyes:
- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Center or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

- If skin or hair contact occurs:

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



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Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
------------------------	---------	------	----------	-----

- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Center.
- Transport to hospital, or doctor.

INHALED

-
- If fumes or combustion products are inhaled remove from contaminated area.
- Lay patient down. Keep warm and rested.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- Transport to hospital, or doctor, without delay.

Inhalation of vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g. lung edema, fluid in the lungs). As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested. Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered. This must definitely be left to a doctor or person authorized by him/her. (ICSC13719).

NOTES TO PHYSICIAN

- Treat symptomatically.

For acute or short term repeated exposures to strong acids:

- Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.
- Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling
- Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
- Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the dessicating action of the acid on proteins in specific tissues.

INGESTION:

- Immediate dilution (milk or water) within 30 minutes post ingestion is recommended.
- DO NOT attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
- Be careful to avoid further vomit since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
- Charcoal has no place in acid management.
- Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

- Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
- Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

- Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. DO NOT use neutralizing agents or any other additives. Several liters of saline are required.
- Cycloplegic drops, (1% cyclopentolate for short-term use or 5% homatropine for longer term use) antibiotic drops, vasoconstrictive agents or artificial tears may be indicated dependent on the severity of the injury.
- Steroid eye drops should only be administered with the approval of a consulting ophthalmologist).

[Ellenhorn and Barceloux: Medical Toxicology].

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG):	Not available
Upper Explosive Limit (%):	Not available
Specific Gravity (water=1):	1.395 (28 C)
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

-
- DO NOT use water.

For chlorosilanes:

- Foam is the most effective agent overall for use on chlorosilane fires. However, a number of variables, most notably the chlorosilane involved, the foam concentrate, the concentration of the foam, the expansion ratio (final foam volume versus initial solution volume), the application equipment and the fire conditions, can have a significant impact on the effectiveness of foam on chlorosilane fires. Certain

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sc-237273

Material Safety Data Sheet



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Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
------------------------	---------	------	----------	-----

combinations of these variables can in fact produce less than satisfactory (and even adverse) results.

- In general, though, alcohol-(polar) compatible AFFF (Aqueous Film Forming Foam) has proven to be an extremely effective foam type, and medium-expansion foam has been found to be the most effective foam expansion. Other foam types and expansions, however, can produce satisfactory results, especially on fires involving dimethyldichlorosilane, trimethylchlorosilane and other heavily organic substituted chlorosilanes. For chlorosilanes containing Si-H (silicon-hydrogen) bonds, e.g., trichlorosilane and methyldichlorosilane, alcohol-compatible AFFF and medium-expansion foam are highly recommended for maximum effectiveness.
- Since foam solutions contain water, reaction with the chlorosilane will normally be observed when foam is applied. Be aware that application of foam will release significant amounts of corrosive vapours. In addition, hydrogen vapours can be released from hydrogen-containing chlorosilanes and may be trapped under the foam blanket. Extreme care should be taken not to disturb the foam blanket during and after foam application.
- Other extinguishing agents that may be effective on small fires include dry sand and carbon dioxide.
- (Caution: When using carbon dioxide in enclosed spaces without adequate ventilation, an asphyxiation hazard can be created.)
- Due to its reactivity with chlorosilanes, water should NOT be used as an extinguishing agent for chlorosilane fires, except for very small fires. Water can also be used to protect exposures and personnel and on the vapour cloud to disperse and dilute the HCl vapour. (Care should be taken, however, to prevent any over-spray or runoff from contacting the chlorosilane.)
- Sodium- and potassium-bicarbonate-based dry chemical fire extinguishers have proven effective to extinguish small chlorosilane fires, except those involving hydrogen-containing chlorosilanes such as trichlorosilane and methyldichlorosilane, where success has been marginal at best. Expect to use much larger quantities of dry chemical than would be required to extinguish a similar hydrocarbon fire. Dry chemical is generally not effective on large fires because an adequate amount of agent cannot be delivered quickly enough. Use of dry chemical on hydrogen-containing chlorosilanes will release hydrogen, which may ignite explosively.
- Prevent extinguishing agents from entering a container or vessel that contains chlorosilane. The resulting release of hydrogen chloride vapours may over-pressurise the container or vessel, resulting in a sudden rupture of the container or vessel.

FIRE FIGHTING

-
- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Fight fire from a safe distance, with adequate cover.
- If safe, switch off electrical equipment until vapor fire hazard removed.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- Avoid spraying water onto liquid pools.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

Foam has proven to be the most effective extinguishing agent on chlorosilane fires. When using foam, the following guidelines should be followed.

- Apply foam as gently as possible. DO NOT 'PLUNGE' OR AIM FOAM STREAMS DIRECTLY INTO A CHLOROSILANE. This will result in severe reactions between the chlorosilane and the water contained in the foam solution.
- Wherever possible, aim foam streams in front of the chlorosilane or bounce off fixed objects (such as tanks or dike walls) to allow the foam to flow gently onto the liquid surface. Occasionally, however, it may be necessary to "lob" foam in order to deliver foam to the centre of a fire.
- Except in the case of very small fires, and where possible, use at least two nozzles to enhance distribution of the foam over the surface of the chlorosilane.
- Establish a relatively thick blanket of foam (e.g., 12 to 18 inches/30 - 50 cm minimum) over the entire liquid surface. Once this has been done, temporarily suspend foam application to allow extinguishing to take place. Reapply foam when the intensity of the fire and/or the evolution of smoke/vapours appear to stabilise or even increase. Repeat this process as often as necessary until extinguishing is effected or until other emergency measures can be initiated.
- It is theorised that the fire is extinguished through the gradual hydrolysis of the chlorosilane by the water draining from the foam. This hydrolysis reaction forms a layer of siloxanes (fluid or gel) on the surface of the chlorosilane, which inhibits vapour production and excludes oxygen, thereby extinguishing the fire.
- Exercise extreme caution when applying foam and when approaching the fire area. The hydrolysis layer formed in the extinguishing process can trap flammable vapours, and, if this layer is disturbed (e.g. by impinging foam-streams), subsurface ignitions and rapid flashovers may occur.
- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- If safe, switch off electrical equipment until vapor fire hazard removed.
- Use water delivered as a fine spray to control fire and cool adjacent area.

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



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Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
------------------------	---------	------	----------	-----

- Avoid spraying water onto liquid pools.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

-
- Liquid and vapor are highly flammable.
- Severe fire hazard when exposed to heat, flame and/or oxidizers.
- Vapor may travel a considerable distance to source of ignition.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).

Combustion products include: carbon dioxide (CO₂), carbon monoxide (CO), hydrogen chloride, phosgene, hydrogen fluoride, silicon dioxide (SiO₂), other pyrolysis products typical of burning organic material.
May emit corrosive fumes.

The chlorosilanes (with the exception of trichlorosilane) burn in a manner similar to burning hydrocarbons, producing large amounts of grey or black smoke. However, the quantity of heat produced by burning chlorosilanes is typically lower than that of most flammable hydrocarbons. Generally speaking, the hydrocarbon-like character of chlorosilanes increases with the number of methyl groups present.

FIRE INCOMPATIBILITY

- Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
- Keep dry
- NOTE: May develop pressure in containers; open carefully. Vent periodically.

PERSONAL PROTECTION

Glasses:

Safety Glasses.

Full face- shield.

Gloves:

Respirator:

Type AB-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

-
- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapors and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb small quantities with vermiculite or other absorbent material.
- Wipe up.
- Collect residues in a flammable waste container.
- Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
- Check regularly for spills and leaks.

An accidental spill or release of chlorosilane results in a hydrogen chloride vapour fog, which should be minimised or controlled as quickly as possible.

- Full protective equipment is needed for individuals who must work in a chlorosilane vapour cloud.
- In the case of spills up to 5 litres, absorb the spill with dry inert absorbent material like dry sand, diatomaceous earth. The resulting material should then be properly packaged and its disposal should be supervised.
- Note: this material will react with water and must carry an appropriate warning label.
- Clear the affected area thoroughly with water.

MAJOR SPILLS

-
- Provide diking or other appropriate containment.
- Cover spill with medium expansion foam (alcohol resistant).
- Pump uncontaminated pure material into appropriate portable tanks, pressure cylinders or drums.
- Neutralise residual material with alkali base. Caution! Hydrogen gas may be evolved during hydrolysis and neutralisation with some chlorosilanes (UN1183, UN1242, UN1295, UN2988). By-products of hydrolysis could be insoluble liquids or solids.

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet

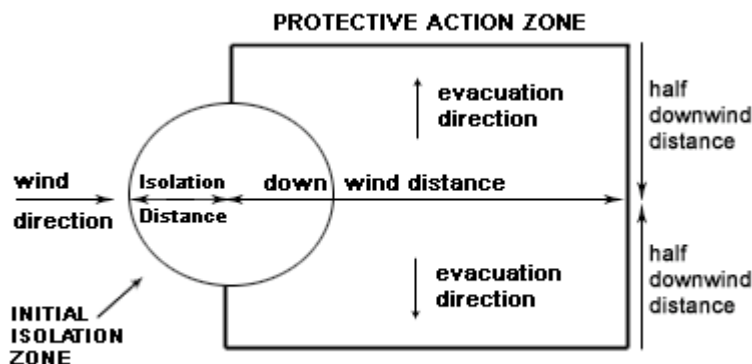


The Power is Question

Hazard Alert Code Key: **EXTREME** **HIGH** **MODERATE** **LOW**

- Hydrogen chloride vapours resulting from a large spill can be reduced by means of a water spray into the acid plume, being careful not to spray water directly into the spilled liquid chlorosilane pool. The resulting acidic waste water requires neutralisation prior to discharge to sewer systems.
- In the event of accidental spillage of chlorosilanes to surface waters or to a municipal sewer system, promptly notify the appropriate pollution control agencies.
- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- No smoking, naked lights or ignition sources.
- Increase ventilation.
- Stop leak if safe to do so.
- Water spray or fog may be used to disperse vapor.
- Contain or absorb spill with sand, earth or vermiculite.
- Use only spark-free shovels and explosion proof equipment.
- Collect recoverable product into labeled containers for recycling.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using. If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL



From US Emergency Response Guide 2000 Guide 155

From IERG (Canada/Australia)

Isolation Distance 25 meters

Downwind Protection Distance 250 meters

SMALL SPILLS

Name	Isolation Distance	Downwind Day	Protection Night
Chlorosilanes, corrosive, flammable, n.o.s. (when spilled in water)	100 ft (30 m)	0.1 mile (0.2 km)	0.2 mile (0.3 km)

LARGE SPILLS

Name	Isolation Distance	Downwind Day	Protection Night
Chlorosilanes, corrosive, flammable, n.o.s. (when spilled in water)	400 ft (125 m)	0.7 mile (1.1 km)	1.8 mile (2.9 km)

FOOTNOTES

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
-------------------------------	----------------	-------------	-----------------	------------

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.

2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.

3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.

4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.

5 Guide 155 is taken from the US DOT emergency response guide book.

6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

3, 3, 3-

trif

luoropropyl

lrichloro

silane

AEGL Type	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	1.8	1.8	1.8	1.8	GALSYN~
AEGL 2	100	43	22	11	GALSYN~
AEGL 3	620	210	100	26	GALSYN~

hydrogen

chloride

AEGL Type	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	1.8	1.8	1.8	1.8	GALSYN~
AEGL 2	100	43	22	11	GALSYN~
AEGL 3	620	210	100	26	GALSYN~

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG)

The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour WITHOUT experiencing or developing

life-threatening health effects is:

3,3,3-trifluoropropyltrichlorosilane 150ppm

irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:

3,3,3-trifluoropropyltrichlorosilane 20ppm

other than mild, transient adverse effects without perceiving a clearly defined odour is:

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
------------------------	---------	------	----------	-----

3,3,3-trifluoropropyltrichlorosilane 3ppm

American Industrial Hygiene Association (AIHA)

Ingredients considered according exceed the following cutoffs

Very Toxic (T+)	>= 0.1%	Toxic (T)	>= 3.0%
R50	>= 0.25%	Corrosive (C)	>= 5.0%
R51	>= 2.5%		
else	>= 10%		

where percentage is percentage of ingredient found in the mixture

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- DO NOT allow clothing wet with material to stay in contact with skin
- For chlorosilanes:
- Static electricity discharges can ignite flammable chlorosilane vapour. It is important to "inert" the whole system, in which chlorosilanes are transferred, with dry nitrogen.
 - Static electricity may be generated when any of these compounds flow through or are discharged from a pipe or fall freely through space. Splash filling is particularly hazardous and should be avoided.
 - To drain off static charges and avoid spark discharges, a continuous path from the point of generation to ground must be provided. This is best accomplished by electrically interconnecting (bonding) all vessels and piping and grounding all vessels and piping.
 - Equipment, such as lines, pumps, valves, vessels, etc., must be thoroughly dried with no trace of water remaining before introducing any chlorosilane.
 - Prior to operation, the system should be tested for leaks at or above operating pressure with dry nitrogen and each joint painted with soap solution and checked for bubbles.
 - Totally enclosed systems should be used. Atmospheric openings or vents will allow moisture to enter the system causing the generation of hydrogen chloride, which will attack the equipment.
 - Use only dry nitrogen, when any of the following is performed: pressurising vessels, priming pumps, blanketing tanks, and filling or withdrawing of tank contents. Operational vents from nitrogen blanketing systems should be directed to a vent recovery system, or a vent scrubber or both.
 - Before withdrawing chlorosilanes from drums, the drum must be electrically grounded and bonded to the receiving container. Chlorosilanes can be withdrawn through a steel valve installed in the drum bung. Dry nitrogen (air or oxygen must not be used due to the flammability of chlorosilanes) should be introduced into the drum through the other bung to replace the volume of liquid. The nitrogen supply system should include a check valve, shut-off valve, pressure regulator and pressure relief valve. The system can be modified to withdraw chlorosilanes by gravity or to feed a pump. Application of pressure to a drum is not recommended.
- Piping and Valves:
- Carbon steel piping is recommended.
 - Welded and flanged piping connections are preferred in order to maintain a leak-tight system.
 - Only flange gaskets which are stable to chlorosilanes (non-asbestos compressed materials, Teflon, graphite) must be used to provide a leak-tight joint. Spiral-wound metallic gaskets or metal/graphite gaskets are preferred when maximum fire resistance is desired.
 - Valves of all sizes can be ductile iron, forged steel, or cast steel valves with stainless steel or steel trim.
 - The interconnection of road / rail tank cars or portable tanks to permanent piping can be made with swing arm rotary joints (best solution) or seamless, braided flexible metal hose. Use flanged or union connections. Do not use quick disconnect couplings.
 - Avoid all personal contact, including inhalation.
 - Wear protective clothing when risk of exposure occurs.
 - Use in a well-ventilated area.
 - WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
 - Avoid smoking, naked lights or ignition sources.
 - Avoid contact with incompatible materials.
 - When handling, DO NOT eat, drink or smoke.
 - Keep containers securely sealed when not in use.
 - Avoid physical damage to containers.
 - Always wash hands with soap and water after handling.
 - Work clothes should be laundered separately.
 - Launder contaminated clothing before re-use.
 - Use good occupational work practice.

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:

EXTREME

HIGH

MODERATE

LOW

- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
- Containers, even those that have been emptied, may contain explosive vapors.
- Do NOT cut, drill, grind, weld or perform similar operations on or near containers.

RECOMMENDED STORAGE METHODS

■ For low viscosity materials

- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.

For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.):

- Removable head packaging;
- Cans with friction closures and
- low pressure tubes and cartridges may be used.

- Where combination packages are used, and the inner packages are of glass, porcelain or stoneware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic. Check regularly for spills and leaks.

For chlorosilanes:

- Non-ferrous metals and alloys such as aluminium, bronze, copper, zinc or magnesium should never be used. They are readily corroded and many, in case of fire, have low melting points.
- Cast iron, due to its brittleness, must not be used to contain chlorosilanes; cast steel and forged steel can be used.
- Plastics should not be used in chlorosilane service due to incompatibility and reactivity of this material.
- In the absence of water, carbon steel is satisfactory for piping and other equipment used to contain chlorosilanes

Glass container.

STORAGE REQUIREMENTS

■

- Store in approved flammable liquid storage area.
- No smoking, naked lights/ignition sources.
- Keep containers securely sealed.
- Store away from incompatible materials in a cool, dry, well-ventilated area.
- Protect containers against physical damage and check regularly for leaks.
- Storage areas should be clearly identified, well illuminated, clear of obstruction and accessible only to trained and authorised personnel - adequate security must be provided so that unauthorised personnel do not have access.
- Store in grounded, properly designed and approved vessels and away from incompatible materials
- Store according to applicable regulations for flammable materials for storage tanks, containers, piping, buildings, rooms, cabinets, allowable quantities and minimum storage distances.
- Use non-sparking ventilation systems, approved explosion proof equipment and intrinsically safe electrical systems.
- Have appropriate extinguishing capability in storage area (e.g. portable fire extinguishers - dry chemical, foam or carbon dioxide) and flammable gas detectors.
- Keep adsorbents for leaks and spills readily available
- For bulk storages, consider use of floating roof or nitrogen blanketed vessels; where venting to atmosphere is possible, equip storage tank vents with flame arrestors; inspect tank vents during winter conditions for vapour/ ice build-up; storage tanks should be above ground and diked to hold entire contents
- Observe manufacturer's storing and handling recommendations.
- Despite the chlorosilanes reactivity with water, water sprinkler systems are the most effective means of protecting buildings, equipment and building contents from chlorosilane fires. Foam-water sprinkler systems can also be used to provide additional extinguishing capabilities (such systems, however, are likely to have only limited effectiveness on trichlorosilane and methyldichlorosilane fires).
- In tank farms and other areas where spilled chlorosilanes would be relatively confined, a permanently installed medium-expansion foam system can be provided to extinguish any chlorosilane fires.
- An adequate number of hydrants and, where appropriate, monitor nozzles should be provided wherever chlorosilanes are stored, handled or processed.
- Of critical importance is the provision of adequate spill control facilities to safely drain away burning chlorosilanes and prevent other important areas and property from being exposed to the fire. This may include such features as diking, curbs, sloped surfaces, drainage trenches and remote impounding areas. Spill control facilities should be designed to accommodate the largest anticipated release of chlorosilanes as well as the quantity of water expected from fire fighting operations (including sprinkler systems, hoses, monitor nozzles, etc.).
- In closed buildings CO₂ may be an adequate extinguishing medium.

Vessels:

- Generally storage tanks should be completely vacuum resistant or should be equipped with automatic pressure controlled nitrogen supply and shut down systems which avoid dangerous under-pressure.

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273



The Power is Question

Material Safety Data Sheet

Hazard Alert Code Key:

EXTREME

HIGH

MODERATE

LOW

- Design pressure is dependent on the properties of the chlorosilanes stored.
- Generally vessels should have emergency vents. Rain hats" should be used over the ends of the vent pipe outlets
- Vessels equipped with pressure-relief valves, to relieve excess internal pressure due to fire or other causes, should employ a non-fragmenting-type rupture disk ahead of or after the relief valve, precautions must be taken to prevent the valve from being blocked with hydrolysis products due to chlorosilane contact with moisture in air. "

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



X: Must not be stored together

O: May be stored together with specific preventions

+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
Canada - British Columbia Occupational Exposure Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride Revised 2003)					2			
Canada - Ontario Occupational Exposure Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					2			
US - Minnesota Permissible Exposure Limits (PELs)	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					5	7		
US ACGIH Threshold Limit Values (TLV)	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					2			TLV Basis: upper respiratory tract irritation
US NIOSH Recommended Exposure Limits (RELs)	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					5	7		
Canada - Alberta Occupational Exposure Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					2	3		
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					5	7		
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)	(C)5	(C)7						
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)					5	7		

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:		EXTREME	HIGH	MODERATE	LOW
US - California Permissible Exposure Limits for Chemical Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride; muriatic acid)			5 7	
US - Idaho - Limits for Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
US - Hawaii Air Contaminant Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
US - Alaska Limits for Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
US - Michigan Exposure Limits for Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)	5	7	-	-
US - Washington Permissible exposure limits of air contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5.0	
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			2	
US - Oregon Permissible Exposure Limits (Z1)	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5	7,5
US OSHA Permissible Exposure Levels (PELs) - Table Z1	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5 7	
Canada - Northwest Territories Occupational Exposure Limits (English)	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			5	7.5
Canada - Nova Scotia Occupational Exposure Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			2	TLV Basis: upper respiratory tract irritation
Canada - Prince Edward Island Occupational Exposure Limits	3,3,3-trifluoropropyltrichlorosilane (Hydrogen chloride)			2	TLV Basis: upper respiratory tract irritation
Canada - British Columbia Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride Revised 2003)			2	
Canada - Ontario Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)			2	
US - Minnesota Permissible Exposure Limits (PELs)	hydrogen chloride (Hydrogen chloride)			5 7	

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:		EXTREME	HIGH	MODERATE	LOW
US ACGIH Threshold Limit Values (TLV)	hydrogen chloride (Hydrogen chloride)			2	
US NIOSH Recommended Exposure Limits (RELs)	hydrogen chloride (Hydrogen chloride)			5	7
Canada - Alberta Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)			2	3
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	hydrogen chloride (Hydrogen chloride)			5	7
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)		(C)5 (C)7		
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)			5	7
US - California Permissible Exposure Limits for Chemical Contaminants	hydrogen chloride (Hydrogen chloride; muriatic acid)			5	7
US - Idaho - Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)			5	7
US - Hawaii Air Contaminant Limits	hydrogen chloride (Hydrogen chloride)			5	7
US - Alaska Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)			5	7
US - Michigan Exposure Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)			5	7
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	hydrogen chloride (Hydrogen chloride)		5 7 - -		
US - Washington Permissible exposure limits of air contaminants	hydrogen chloride (Hydrogen chloride)			5.0	
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	hydrogen chloride (Hydrogen chloride)			2	
US - Oregon Permissible Exposure Limits (Z1)	hydrogen chloride (Hydrogen chloride)			5	7
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	hydrogen chloride (Hydrogen chloride)			5	7
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	hydrogen chloride (Hydrogen chloride)			5	7,5

TLV Basis:
upper
respiratory tract
irritation

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:		EXTREME	HIGH	MODERATE	LOW
US OSHA Permissible Exposure Levels (PELs) - Table Z1	hydrogen chloride (Hydrogen chloride)			5	7
Canada - Northwest Territories Occupational Exposure Limits (English)	hydrogen chloride (Hydrogen chloride)			5	7.5
Canada - Nova Scotia Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)			2	TLV Basis: upper respiratory tract irritation
Canada - Prince Edward Island Occupational Exposure Limits	hydrogen chloride (Hydrogen chloride)			2	TLV Basis: upper respiratory tract irritation
EMERGENCY EXPOSURE LIMITS					
Material	Revised IDLH Value (mg/m3)		Revised IDLH Value (ppm)		
3,3,3-trifluoropropyltrichlorosilane			50		
hydrogen chloride			50		

MATERIAL DATA

3,3,3-TRIFLUOROPROPYLTRICHLOROSILANE:

HYDROGEN CHLORIDE:

■ for hydrogen chloride:

Odour Threshold Value: 0.262 ppm (detection), 10.06 ppm (recognition)

NOTE: Detector tubes for hydrochloric acid, measuring in excess of 1 ppm, are available commercially.

Hydrogen chloride is a strong irritant to the eyes, mucous membranes and skin. Chronic exposure produces a corrosive action on the teeth. Reports of respiratory irritation following short-term exposure at 5 ppm have lead to the recommended TLV-C. There is no indication that skin contact with hydrogen chloride elicits systemic poisoning and a skin designation has not been applied.

Exposure of humans to hydrogen chloride at 50 to 100 ppm for 1 hour is reported to be barely tolerable; 35 ppm caused irritation of the throat on short exposure and 10 ppm was the maximal concentration for prolonged exposure. It has been stated that hydrogen chloride at concentrations of 5 ppm is immediately irritating.

Odour Safety Factor(OSF)

OSF=1.3 (HYDROGEN CHLORIDE).

PERSONAL PROTECTION



Consult your EHS staff for recommendations

EYE

- Chemical goggles.
- Full face shield.
- Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

HANDS/FEET

■ Elbow length PVC gloves.

- When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273



The Power is Question

Material Safety Data Sheet

Hazard Alert Code Key:

EXTREME

HIGH

MODERATE

LOW

- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

- Neoprene gloves

OTHER

- For chlorosilanes:

- Viton and similar synthetic rubbers afford the best protection
- PVC and nitrile rubber may be used as a protective material (gloves, clothing and boots) for short term contacts in normal handling procedures to prevent skin burns.
- Latex rubber should not be used.
- The importance of water washing in the safety shower/eyewash for a minimum of 15 minutes after contact with chlorosilanes should be emphasised.
- Contaminated clothing and shoes must be removed before the person is washed under the safety shower. The assistance by another person to help remove clothing and, perhaps, to help hold eyes open in the eyewash may be necessary.
- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets), non sparking safety footwear.

RESPIRATOR

- Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half-face Respirator	Full-Face Respirator
1000	10	AB-1 P	-
1000	50	-	AB-1 P
5000	50	Airline*	-
5000	100	-	AB-2 P
10000	100	-	AB-3 P
	100+		Airline* *

* - Continuous Flow ** - Continuous-flow or positive pressure demand.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.

Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

- Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:
solvent, vapors, degreasing etc., evaporating from tank (in still air).	0.25-0.5 m/s (50-100 f/min.)
aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)	0.5-1 m/s (100-200 f/min.)

direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion) 1-2.5 m/s (200-500 f/min.)

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
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grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion). 2.5-10 m/s (500-2000 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favorable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.

Corrosive.

Acid.

Reacts violently with water.

State	Liquid	Molecular Weight	231.50
Melting Range (°F)	Not available	Viscosity	Not Available
Boiling Range (°F)	235.4- 237.2	Solubility in water (g/L)	Reacts
Flash Point (°F)	Not available	pH (1% solution)	Not available
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Not available
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	1.395 (28 C)
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	>1
Volatile Component (%vol)	Not available	Evaporation Rate	Not available

APPEARANCE

Colourless liquid; hydrolyses in water.

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

-
- Presence of incompatible materials
- Contact with alkaline material liberates heat

STORAGE INCOMPATIBILITY

- Chlorosilanes:
 - react with water to produce heat and toxic, corrosive fumes of hydrogen chloride and possibly H₂.
 - react vigorously with both organic and inorganic acids and with bases to generate toxic or flammable gases.
 - react with primary alcohols (almost as rapidly as water) forming hydrogen chloride; secondary and tertiary alcohols react less rapidly
 - react rapidly with ammonia and aliphatic amines generating heat and ammonium and amine salts
 - (hydrogen-containing) react violent with chlorine
 - Measurement of the autoignition temperatures of several series of mono-, di-, tri- and tetra- alkylsilanes showed the ease of oxidation

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
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decreases with increasing substitution.

- Some alkylsilanes are easily ignited or are pyrophoric.

BREThERICK L.: Handbook of Reactive Chemical Hazards.

Hydrogen chloride:

- reacts strongly with strong oxidisers (releasing chlorine gas), acetic anhydride, caesium cyanotridecahydrodecaborate(2-), ethylidene difluoride, hexalithium disilicide, metal acetylide, sodium, silicon dioxide, tetraselenium tetranitride, and many organic materials
- is incompatible with aliphatic amines, alkanolamines, alkylene oxides, aluminium, aluminium-titanium alloys, aromatic amines, amides, 2-aminoethanol, ammonia, ammonium hydroxide, calcium phosphide, chlorosulfonic acid, ethylenediamine, ethyleneimine, epichlorohydrin, isocyanates, metal acetylides, metal carbides, oleum, organic anhydrides, perchloric acid, 3-propiolactone, sulfuric acid, uranium phosphide, vinyl acetate, vinylidene fluoride
- attacks most metals forming flammable hydrogen gas, and some plastics, rubbers and coatings

Reacts with mild steel, galvanized steel / zinc producing hydrogen gas which may form an explosive mixture with air.

Segregate from alkalis, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

- NOTE: May develop pressure in containers; open carefully. Vent periodically.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

3,3,3-trifluoropropyltrichlorosilane

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

■ Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.

The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

The material may produce respiratory tract irritation, and result in damage to the lung including reduced lung function.

The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

No significant acute toxicological data identified in literature search.

CARCINOGEN

Hydrochloric acid	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Hydrogen chloride	US ACGIH Threshold Limit Values (TLV) - Carcinogens	Carcinogen Category	A4

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

HYDROGEN CHLORIDE:

3,3,3-TRIFLUOROPROPYLTRICHLOROSILANE:

■ DO NOT discharge into sewer or waterways.

3,3,3-TRIFLUOROPROPYLTRICHLOROSILANE:

■ For chlorosilanes:

The impact of chlorosilane on the environment is mainly in the air compartment. The acidic fumes will burn plants and trees that come in contact with it. The impact on the terrestrial environment is limited and local. Contaminated soil should be neutralised and sent for disposal. Spills in the aquatic environment result in an increase in water acidity (because of the hydrochloric acid formation) which may harm aquatic life.

■ Prevent, by any means available, spillage from entering drains or watercourses.

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key: **EXTREME** **HIGH** **MODERATE** **LOW**

HYDROGEN CHLORIDE:

■ Although inorganic chloride ions are not normally considered toxic they can exist in effluents at acutely toxic levels (chloride >3000 mg/l). the resulting salinity can exceed the tolerances of most freshwater organisms.

Inorganic chlorine eventually finds its way into the aqueous compartment and as such is bioavailable. Incidental exposure to inorganic chloride may occur in occupational settings where chemicals management policies are improperly applied. The toxicity of chloride salts depends on the counter-ion (cation) present; that of chloride itself is unknown. Chloride toxicity has not been observed in humans except in the special case of impaired sodium chloride metabolism, e.g. in congestive heart failure. Healthy individuals can tolerate the intake of large quantities of chloride provided that there is a concomitant intake of fresh water.

Although excessive intake of drinking-water containing sodium chloride at concentrations

above 2.5 g/litre has been reported to produce hypertension, this effect is believed to be related to the sodium ion concentration.

Chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water, but the threshold depends upon the associated cations. Consumers can, however, become accustomed to concentrations in excess of 250 mg/litre. No health-based guideline value is proposed for chloride in drinking-water.

In humans, 88% of chloride is extracellular and contributes to the osmotic activity of body fluids. The electrolyte balance in the body is maintained by adjusting total dietary intake and by excretion via the kidneys and gastrointestinal tract. Chloride is almost completely absorbed in normal individuals, mostly from the proximal half of the small intestine. Normal fluid loss amounts to about 1.5?2 liters/day, together with about 4 g of chloride per day. Most (90 - 95%) is excreted in the urine, with minor amounts in faeces (4- %) and sweat (2%)

Chloride increases the electrical conductivity of water and thus increases its corrosivity. In metal pipes, chloride reacts with metal ions to form soluble salts thus increasing levels of metals in drinking-water. In lead pipes, a protective oxide layer is built up, but chloride enhances galvanic corrosion. It can also increase the rate of pitting corrosion of metal pipes.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
3,3,3-trifluoropropyltrichlorosilane	LOW		LOW	HIGH
hydrogen chloride	LOW		LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

A. General Product Information

Ignitability characteristic: use EPA hazardous waste number D001 (waste code I)

Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.

! Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.

A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction
- Reuse
- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

- Recycle wherever possible.
- Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.
- Treat and neutralize at an approved treatment plant. Treatment should involve: Neutralization with soda-ash or soda-lime followed by: Burial in a licensed land-fill or Incineration in a licensed apparatus
- Decontaminate empty containers with 5% aqueous sodium hydroxide or soda ash, followed by water. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
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DOT:

Symbols:	None	Hazard class or Division:	8
Identification Numbers:	UN2986	PG:	II
Label Codes:	8, 3	Special provisions:	T14, TP2, TP7, TP13, TP27
Packaging: Exceptions:	None	Packaging: Non-bulk:	206
Packaging: Exceptions:	None	Quantity limitations: Passenger aircraft/rail:	1 L
Quantity Limitations: Cargo aircraft only:	30 L	Vessel stowage: Location:	C
Vessel stowage: Other:	40		

Hazardous materials descriptions and proper shipping names:

Chlorosilanes, corrosive, flammable, n.o.s

Air Transport IATA:

ICAO/IATA Class:	8 (3)	ICAO/IATA Subrisk:	None
UN/ID Number:	2986	Packing Group:	II
Special provisions:	None		

Shipping Name: CHLOROSILANES, CORROSIVE, FLAMMABLE, N.O.S.(CONTAINS 3,3,3-TRIFLUOROPROPYLTRICHLOROSILANE)

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	3
UN Number:	2986	Packing Group:	II
EMS Number:	F-E,S-C	Special provisions:	None

Limited Quantities: None

Shipping Name: CHLOROSILANES, CORROSIVE, FLAMMABLE, N.O.S.(contains 3,3,3-trifluoropropyltrichlorosilane)

Section 15 - REGULATORY INFORMATION

3,3,3-trifluoropropyltrichlorosilane (CAS: 592-09-6) is found on the following regulatory lists;

"Canada Non-Domestic Substances List (NDSL)", "US Toxic Substances Control Act (TSCA) - Inventory"

Regulations for ingredients

hydrogen chloride (CAS: 7647-01-0) is found on the following regulatory lists;

"Canada - Alberta Ambient Air Quality Objectives", "Canada - Alberta Occupational Exposure Limits", "Canada - British Columbia Occupational Exposure Limits", "Canada - Northwest Territories Occupational Exposure Limits (English)", "Canada - Nova Scotia Occupational Exposure Limits", "Canada - Ontario Occupational Exposure Limits", "Canada - Prince Edward Island Occupational Exposure Limits", "Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)", "Canada - Saskatchewan Industrial Hazardous Substances", "Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits", "Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances", "Canada Controlled Drugs and Substances Act Schedule VI", "Canada Domestic Substances List (DSL)", "Canada Ingredient Disclosure List (SOR/88-64)", "Canada National Pollutant Release Inventory (NPRI)", "Canada Prohibited Toxic Substances, Schedule 2, Concentration Limits (English)", "Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)", "Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)", "CODEX General Standard for Food Additives (GSFA) - Additives Permitted for Use in Food in General, Unless Otherwise Specified, in Accordance with GMP", "GESAMP/EHS Composite List - GESAMP Hazard Profiles", "IMO IBC Code Chapter 17: Summary of minimum requirements", "IMO MARPOL 73/78 (Annex II) - List of Noxious Liquid Substances Carried in Bulk", "International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs", "International Council of Chemical Associations (ICCA) - High Production Volume List", "International Maritime Dangerous Goods Requirements (IMDG Code) - Goods Forbidden for Transport", "OECD Representative List of High Production Volume (HPV) Chemicals", "United Nations Convention Against Illicit Traffic in

Trichloro(3,3,3-trifluoropropyl)silane

sc-237273

Material Safety Data Sheet



The Power is Question

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW
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Narcotic Drugs and Psychotropic Substances - Table II,"United Nations List of Precursors and Chemicals Frequently used in the Illicit Manufacture of Narcotic Drugs and Psychotropic Substances Under International Control - Table II","US - Alaska Limits for Air Contaminants","US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)","US - California OEHHA/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)","US - California Permissible Exposure Limits for Chemical Contaminants","US - California Toxic Air Contaminant List Category II","US - Connecticut Hazardous Air Pollutants","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Massachusetts Oil & Hazardous Material List","US - Michigan Exposure Limits for Air Contaminants","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances","US - Oregon Hazardous Materials","US - Oregon Permissible Exposure Limits (Z1)","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Permissible exposure limits of air contaminants","US - Wyoming List of Highly Hazardous Chemicals, Toxics and Reactives","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US Clean Air Act - Hazardous Air Pollutants","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","US Department of Homeland Security Chemical Facility Anti-Terrorism Standards - Chemicals of Interest","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US DOE Temporary Emergency Exposure Limits (TEELs)","US Drug Enforcement Administration (DEA) List I and II Regulated Chemicals","US EPA Acute Exposure Guideline Levels (AEGLs) - Final","US EPA High Production Volume Chemicals Additional List","US EPA Master Testing List - Index I Chemicals Listed","US EPCRA Section 313 Chemical List","US Food Additive Database","US List of Lists - Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the Clean Air Act","US NFPA 45 Fire Protection for Laboratories Using Chemicals - Flammability Characteristics of Common Compressed and Liquefied Gases","US NIOSH Recommended Exposure Limits (RELs)","US OSHA List of Highly Hazardous Chemicals, Toxics and Reactives","US OSHA Permissible Exposure Levels (PELs) - Table Z1","US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide","US SARA Section 302 Extremely Hazardous Substances","US Spacecraft Maximum Allowable Concentrations (SMACs) for Airborne Contaminants","US Toxic Substances Control Act (TSCA) - Inventory"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Cumulative effects may result following exposure*.

* (limited evidence).

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■ Classification of the mixture and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

A list of reference resources used to assist the committee may be found at:

www.chemwatch.net/references.

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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