BOC GASES

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: SILANE

1. Chemical Product and Company Identification

BOC Gases,
Division of,
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE NUMBER: CHEMTREC (800) 424-9300

BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER: (905) 501-0802
EMERGENCY RESPONSE PLAN NO: 2-0101

PRODUCT NAME: SILANE
CHEMICAL NAME: Silicon Tetrahydride
COMMON NAMES/SYNONYMS: Silicon Tetrahydride, Monosilane, Silicane, Silicon Hydride (SiH_4)
TDG (Canada) CLASSIFICATION: 2.1
WHMIS CLASSIFICATION: A, D2B, B6

PREPARED BY: Loss Control (908)464-8100/(905)501-1700
PREPARATION DATE: 6/1/95
REVIEW DATES: 6/1/99

2. Composition, Information on Ingredients

EXPOSURE LIMITS[1]:

INGREDIENT	% VOLUME	PEL-OSHA[2]	TLV-ACGIH[3]	LD_{50} or LC_{50} Route/Species
Silicon Tetrahydride FORMULA: SiH_4 CAS: 7803-62-5 RTECS #: VV1400000	100.0	None Established	5 ppm TWA	LC_{50}: 1900 ppm (ISO, CGA P-20)

[1] Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.
[2] As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)
[3] As stated in the ACGIH 1998-1999 Threshold Limit Values for Chemical Substances and Physical Agents.

OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.

3. Hazards Identification

EMERGENCY OVERVIEW

Colorless highly flammable gas with repulsive odor. Irritating to the eyes, skin and mucous membranes. Hydrolysis of silane inside of body tissues may produce silicic acid. Dangerous fire and explosion hazard. Avoid heat, sparks, and flames. Releases may ignite spontaneously. This product may spontaneously combust in air. Contents under pressure. Use and store below 125 °F.

ROUTE OF ENTRY:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
Yes	No	Yes	Yes	No

HEALTH EFFECTS:

Exposure Limits	Irritant	Sensitization
Yes	Yes	No
Teratogen	Reproductive Hazard	Mutagen
No	No	No
Synergistic Effects None reported		

Carcinogenicity: -- NTP: No IARC: No OSHA: No

EYE EFFECTS:
Contact may form silicic acid with resultant irritation.

SKIN EFFECTS:
Skin burns from ignited silane are similar to other thermal burns. Contact may cause irritation.

INGESTION EFFECTS:
Since product is a gas at room temperature, ingestion is unlikely. Contact may form silicic acid causing irritation.

INHALATION EFFECTS:
Inhalation may cause respiratory irritation. Symptoms of inhalation are not well defined. It has been reported that breathing this gas may cause headache or nausea. The hydrolysis of silane in the body tissues would form silicic acid or hydrated silica.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: May aggravate pre-existing, eye, skin, and respiratory conditions.

NFPA HAZARD CODES	HMIS HAZARD CODES	RATINGS SYSTEM
Health: 1	Health: 0	0 = No Hazard
Flammability: 4	Flammability: 4	1 = Slight Hazard
Instability: 3	Reactivity: 3	2 = Moderate Hazard
		3 = Serious Hazard
		4 = Severe Hazard

4. First Aid Measures

EYES:
Flush eyes with water or sterile saline for at least 15 minutes. See physician for follow up.

SKIN:
Flush skin with water and remove contaminated clothing. Dermal burns from ignited silane should be treated as with any thermal burn. Wash affected area with water. If irritation persists see physician.

INGESTION:
Not anticipated.

INHALATION:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND BE AWARE OF EXTREME FIRE AND EXPLOSION HAZARD. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. If breathing is difficult, administer oxygen. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given artificial resuscitation and supplemental oxygen. Medical assistance should be sought immediately. Treatment should be symptomatic and supportive.

5. Fire Fighting Measures

Conditions of Flammability: Spontaneously combustible at room temperature in air		
Flash point: Pyrophoric	Method: Not Applicable	Autoignition Temperature: Not Available
LEL(%): 1.4 (estimated)*	UEL(%): 96 (estimated)*	
Hazardous combustion products: Silicon fumes and hydrogen (above 752 °F)		
Sensitivity to mechanical shock: Not Available		
Sensitivity to static discharge: Not Available		

*(NFPA Fire Protection Guide to Hazardous Materials, 12th Ed., 1997).

FIRE AND EXPLOSION HAZARDS:
Spontaneously combustible (pyrophoric). Pure silane releases may spontaneously ignite. Explosive decomposition may occur under fire conditions. Cylinder may rupture violently from pressure when involved in a fire situation.

EXTINGUISHING MEDIA:
Do not use halocarbons. May explode with halocarbons when ignited. Stop the flow of gas before extinguishing fire. Use water spray to cool surrounding containers.

FIRE FIGHTING INSTRUCTIONS:
Shut off source of product if safe to do so. Fight fire from protected location or maximum distance. Use water spray or fog to control fire, disperse vapors and protect personnel.

If possible, stop the flow of gas. Inerting the atmosphere to reduce oxygen levels may extinguish flame, allowing capping of leaking container. Do not attempt this unless specifically trained. Reduce the rate of flow and inject an inert gas, if possible, before completely stopping the flow to prevent flashback. Do not extinguish the fire until the supply is shut off as otherwise an explosive reignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. Direct 500 GPM water stream onto containers above liquid level with remote monitors. Limit the number of personnel in proximity of fire and evacuate surrounding areas in all directions.

Firefighters should wear respiratory protection (SCBA) and full turnout or Bunker gear. Continue to cool fire-exposed cylinders until well after flames are extinguished.

6. Accidental Release Measures

Releases may ignite spontaneously. Immediately evacuate all personnel from affected area and extinguish all ignition sources. No smoking, flares, flames or sparks in hazard area. Use water spray to disperse vapors and protect personnel. Stop or control leak if it can be done without risk. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

7. Handling and Storage

Earth ground and bond all lines and equipment associated with the system. All equipment should be non-sparking or explosion-proof.

Pure silane is noncorrosive and may be handled in most common structural containers. Carbon steel, stainless steel, copper, brass, Monel ® & Hasteloy C are the most commonly used materials. It is also compatible with ordinary glass, Pyrex ®, and quartz. For gasket materials, Viton ®, Nylon, Teflon ®, and Kel-F ® are all satisfactory. Most all silane leaks will ignite in air producing silicon dioxide. Occasionally the silicon dioxide will slow or stop the leak. These leaks are recognizable by the presence of the silicon dioxide and permanent repairs to the leak should be made.

Use only in well-ventilated areas. Stationary customer site vessels should be operated in accordance with the manufacturer's and BOC instructions. Do not attempt to repair, adjust or in any other way modify the operation of these vessels. If there is a malfunction or other type of operations problem with the vessel, contact the closest BOC location immediately for assistance.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas, emergency exits, and incompatible materials. DO NOT allow the temperature where cylinders are stored to exceed 125^{o}F (52^{o}C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in- first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Post “NO SMOKING” signs in storage and use areas. There should be no sources of ignition in areas where this product is being used or stored.

Valve protection caps must remain in place unless container is secured with valve outlet piping to use point. Close valve after each use and when the container is empty. Do not drag, slide or roll cylinders on their sides. Use a suitable hand truck for container movement. Use a pressure reducing regulator when connecting container to piping or systems. Do not use gas directly from container. Do not heat container by any means to increase the discharge rate of product from the container.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

For additional storage recommendations, consult Compressed Gas Association Pamphlets P-1.

8. Exposure Controls, Personal Protection

ENGINEERING CONTROLS:
Use local exhaust ventilation to reduce concentrations to within current exposure limits. A laboratory type hood is suitable for handling small or limited quantities. Use general area ventilation to maintain oxygen levels above 19.5% by volume minimum.

EYE/FACE PROTECTION:
Safety goggles.

SKIN PROTECTION:
Protective gloves: neoprene, butyl rubber, PVC, polyethylene.

RESPIRATORY PROTECTION:
Airline respirators with full-face piece equipped with an escape bottle or a self-contained breathing apparatus should be available for emergency use. Operate this equipment in positive pressure mode.

OTHER/GENERAL PROTECTION:
Safety shoes, safety shower and eyewash.

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure	: Not Available	
Vapor density (Air = 1)	: Not Available	
Evaporation point	: Not Available	
Boiling point	: -170	^{o}F
	: -112	^{o}C
Freezing point	: -301	^{o}F
	: -185	^{o}C
pH	: Not Available	
Specific gravity at STP	: 1.1	
Oil/water partition coefficient	: Not Available	
Solubility	: Insoluble	
Odor threshold	: Not Available	
Odor and appearance	: Colorless gas with repulsive odor	

10. Stability and Reactivity

STABILITY:
May ignite spontaneously on exposure to air.

INCOMPATIBLE MATERIALS:
Alkalies, oxidizing materials, halogens, and air. Explosive reaction/ignition on contact with covalent halides or halogens. Ignites on contact with oxygen.

HAZARDOUS DECOMPOSITION PRODUCTS:
Silicon and hydrogen at 788^{o}F (420^{o}C).

HAZARDOUS POLYMERIZATION:
Will not occur.

11. Toxicological Information

INHALATION:
Toxicological data for silane in the open literature is extremely limited. Four of ten mice died following inhalation of 9600 ppm for 4 hours. The four hour LC50 for the rat is 9600 ppm.

In the absence of subacute or chronic data for silane, the ACGIH TLV is based on silicon tetrahydride being one-tenth as toxic as germanium tetrahydride. The margin of safety associated with this TLV has yet to be determined.

SKIN AND EYE:
Limited data. May cause irritation.

CHRONIC:
No Data

12. Ecological Information

No data given.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Silane, Compressed	Silane
HAZARD CLASS:	2.1	2.1
IDENTIFICATION NUMBER:	UN 2203	UN 2203
SHIPPING LABEL:	FLAMMABLE GAS	FLAMMABLE GAS

15. Regulatory Information

Silane is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

SARA TITLE III NOTIFICATIONS AND INFORMATION

SARA TITLE III - HAZARD CLASSES:
Acute Health Hazard
Fire Hazard
Sudden Release of Pressure Hazard
Reactivity Hazard

16. Other Information

ACGIH	American Conference of Governmental Industrial Hygienists
DOT	Department of Transportation
IARC	International Agency for Research on Cancer
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
STEL	Short Term Exposure Limit
TDG	Transportation of Dangerous Goods
TLV	Threshold Limit Value
WHMIS	Workplace Hazardous Materials Information System

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

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