

PRODUCT NAME: SILANE (5 PPM – 15%) IN NITROGEN, HELIUM OR ARGON**1. Product and Company Identification**

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

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

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

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

PRODUCT NAME: SILANE (5 PPM TO 15%) IN NITROGEN, HELIUM OR ARGON
CHEMICAL NAME: Silicon Tetrahydride in Nitrogen, Helium or Argon
COMMON NAMES/SYNONYMS: Silicon Tetrahydride in Nitrogen, Helium or Argon
TDG (Canada) CLASSIFICATION: 2.1
WHMIS CLASSIFICATION: A, D2B, B1, B6

PREPARED BY: Loss Control (908)464-8100/(905)501-1700
PREPARATION DATE: 6/1/95
REVIEW DATES: 07/16/04

2. Composition, Information on Ingredients**EXPOSURE LIMITS¹:**

INGREDIENT	% VOLUME	PEL-OSHA²	TLV-ACGIH³	LD₅₀ or LC₅₀ Route/Species
Nitrogen FORMULA: N ₂ CAS: 7727-37-9 RTECS #: QW9700000	0 to 99.9995	None Established	Simple Asphyxiant	Not Available
Helium FORMULA: He CAS: 7440-59-7 RTECS #: MH6520000	0 to 99.9995	None Established	Simple Asphyxiant	Not Available
Argon FORMULA: Ar CAS: 7440-37-1 RTECS #: CF2300000	0 to 99.9995	None Established	Simple Asphyxiant	Not Available
Silane FORMULA: SiH ₄ CAS: 7803-62-5 RTECS #: W1400000	0.0005 to 15.0	Not Available	5 ppm TWA	LC ₅₀ : 19000 ppm (ISO, CGA P-20)

¹ As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

² Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

³ As stated in the ACGIH 2004 Threshold Limit Values for Chemical Substances and Physical Agents.

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

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3. Hazards Identification

EMERGENCY OVERVIEW

Colorless gas with repulsive odor. Flammability depends on the concentration of silane in the mixture (See Section 5). Flammable mixtures are a fire and explosion hazard and may spontaneously combust in air. Avoid heat, sparks, and flames. Irritating to the eyes, skin and mucous membranes. Hydrolysis of silane inside of body tissues may produce silicic acid. Contents under pressure. Use and store below 125 °F.

ROUTE OF ENTRY:

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion No
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HEALTH EFFECTS:

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

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

EYE EFFECTS: Contact may form silicic acid with resultant irritation. Ignited product may cause thermal burns

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. Consult a physician for treatment. 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 may form silicic acid or hydrated silica.

Nitrogen, Helium and Argon are simple asphyxiants. Maintain oxygen levels above 19.5%. Effects of oxygen deficiency resulting from simple asphyxiants may include: rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgment, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma and death.

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

POTENTIAL ENVIRONMENTAL EFFECTS: No Data. Not expected to be highly toxic as indicated by the relatively high LC₅₀ for silane.

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: Not Available	Method: Not Applicable	Autoignition Temperature: Not Available
LEL(%): 1.4*	UEL(%): 96*	
Hazardous combustion products: Silicon compounds		
Sensitivity to mechanical shock: Not Available		
Sensitivity to static discharge: Not Available		

* Estimated as silane, NFPA Fire Protection Guide to Hazardous Materials, 13th Ed., 2002.

FIRE AND EXPLOSION HAZARDS: Pure silane is spontaneously combustible (pyrophoric). Flammability of mixture is dependent on concentration of silane present. Concentrations of > 0.8% silane in argon, > 1.0% in helium, and > 1.5% in nitrogen are flammable. (CGA P-23, 2003) Silane releases may spontaneously ignite and decompose explosively under fire conditions. Fire and explosion risks increase as silane concentration increases. Cylinder may vent rapidly or rupture violently from pressure when involved in a fire situation.

EXTINGUISHING MEDIA: For flammable mixtures, stop the flow of gas. Do not use halocarbons. Use water, dry chemical, carbon dioxide.

FIRE FIGHTING INSTRUCTIONS: 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

Evacuate all personnel from affected area. For flammable mixtures, immediately extinguish all ignition sources. No smoking, flares, flames, or sparks in hazard area. Use appropriate protective equipment (See Section 8). Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. Provide maximum ventilation and ventilate enclosed areas. For flammable mixtures, ventilation must be appropriate for use in a potentially flammable atmosphere. 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

For flammable mixtures, 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. Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. DO NOT allow the temperature where cylinders are stored to exceed 125°F (52°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.

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. Do not insert any object (i.e.: screwdriver) into valve cap openings as this can damage the valve causing leakage.

For flammable mixtures: Post "NO SMOKING" signs in use and storage areas. There should be no sources of ignition in areas where this product is being used or stored. Outside or detached storage is preferred.

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 and general ventilation systems to control air contaminants at or below acceptable exposure guidelines. Small quantities can be handled in forced ventilation hoods. If product is handled routinely where the potential for leaks exists, all electrical equipment must be rated for use in potentially flammable atmospheres. Consult the National Electrical Code for details.

EYE/FACE PROTECTION: Safety goggles or glasses.

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SKIN PROTECTION: Protective gloves: neoprene, butyl rubber, PVC, polyethylene. Thermal protection is recommended for flammable mixtures.

RESPIRATORY PROTECTION: For emergency release use a positive pressure NIOSH approved air-supplying respirator systems (SCBA or airline/escape bottle) using at a minimum Grade D air.

OTHER/GENERAL PROTECTION: Safety shoes, 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 (SiH ₄)	: -170	°F
	: -112	°C
Freezing point (SiH ₄)	: -301	°F
	: -185	°C
pH	: Not Available	
Specific gravity at STP (SiH ₄)	: 1.1	
Oil/water partition coefficient	: Not Available	
Solubility (H ₂ O)	: Insoluble	
Odor threshold	: Not Available	
Odor and appearance	: Colorless gas with repulsive odor	

10. Stability and Reactivity

STABILITY: Silane may ignite spontaneously on exposure to air.

INCOMPATIBLE MATERIALS/CONDITIONS: Concentrations of > 0.5% silane in argon, > 0.67% in helium, and > 1% in nitrogen are flammable. Silane is incompatible with halides, halogens, alkalies, oxidizing materials, and air. Ignites on contact with oxygen.

HAZARDOUS DECOMPOSITION PRODUCTS: Silicon and hydrogen at 788°F (420°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 has been cited as both 4000 ppm and 9600 ppm.

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

SKIN AND EYE: Limited data. May cause irritation.

OTHER: No data

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12. Ecological Information

Product does not contain Class I or Class II ozone depleting substances. Not toxic. Will not bioconcentrate.

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:	Compressed gas, flammable, n.o.s. (Silane in Nitrogen or Helium or Argon)*	Compressed gas, flammable, n.o.s. (Silane)
HAZARD CLASS:	2.1	2.1
IDENTIFICATION NUMBER:	UN 1954	UN 1954
SHIPPING LABEL:	FLAMMABLE GAS	FLAMMABLE GAS

Note: Mixtures with $\leq 1.5\%$ silane in nitrogen, $\leq 1.0\%$ silane in helium, and $\leq 0.80\%$ silane in argon may be shipped as Compressed gases, n.o.s., (Silane, Nitrogen, Helium, Argon), 2.2 , UN 1956, NONFLAMMABLE GAS.

* Dependent on gas present in mixture (i.e.: nitrogen, helium, or argon)

15. Regulatory Information

SARA TITLE III NOTIFICATIONS AND INFORMATION

SARA TITLE III - HAZARD CLASSES:

Acute Health Hazard
Fire Hazard (flammable mixtures)
Sudden Release of Pressure Hazard
Reactivity Hazard (Silane concentrations > 1%)

SARA TITLE III - SECTION 313 SUPPLIER NOTIFICATION:

This product does not contain toxic chemicals subject to reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372.

U.S. TSCA/Canadian DSL: All ingredients are listed on the U.S. Toxic Substances Control Act (TSCA) inventory or exempt from listing and on the Canadian Domestic Substance List (DSL).

California Proposition 65: This product does not contain ingredient(s) known to the State of California to cause cancer or reproductive toxicity.

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

16. Other Information

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

* As silane/silica tetrahydride

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2004, *CGA Recommended Hazard Ratings for Compressed Gases, 2nd Edition*.

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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