SILANE
Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name	SILANE
Product Code(s)	G-97, 1021
UN-Number	UN2203
Recommended Use	Compressed gas.
Synonyms	Silicon Tetrahydride; Monosilane; Silicane; Silicon Hydride (SiH4)
Supplier Address*	Linde Gas North America LLC - Linde Merchant Production Inc. - Linde LLC 575 Mountain Ave. Murray Hill, NJ 07974 Phone: 908-464-8100 www.lindeus.com Linde Gas Puerto Rico, Inc. Las Palmas Village Road No. 869, Street No. 7 Catano, Puerto Rico 00962 Phone: 787-641-7445 www.pr.lindegas.com Linde Canada Limited 5860 Chedworth Way Mississauga, Ontario L5R 0A2 Phone: 905-501-1700 www.lindecanada.com * May include subsidiaries or affiliate companies / divisions. For additional product information contact your local customer service.
Chemical Emergency Phone Number	Chemtrec: 1-800-424-9300 for US / 703-527-3887 outside US

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Extremely flammable
Pyrophoric gas-Dangerous fire and explosion hazard
Irritating to eyes, respiratory system and skin
Contents under pressure
Keep at temperatures below 52°C / 125°F

Appearance Colorless | Physical State Compressed gas. | Odor Pungent

OSHA Regulatory Status	This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Potential Health Effects

Principle Routes of Exposure	Inhalation. Eye contact. Skin contact.
Acute Toxicity	
Inhalation	May cause irritation of respiratory tract. Exposure to silane may cause headache and nausea. The hydrolysis of silane in the body tissues would form silicic acid and hydrated silica.
Eyes	Contact may form silicic acid causing irritation.
Skin	Contact may form silicic acid causing irritation. Ignited gas can cause thermal burns.
Skin Absorption Hazard	No known hazard in contact with skin.
Ingestion	Not an expected route of exposure. May cause irritation.
Chronic Effects	None known
Aggravated Medical Conditions	Skin disorders. Respiratory disorders. Pre-existing eye disorders.
Environmental Hazard	See Section 12 for additional Ecological Information.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Volume %	Chemical Formula
Silane	7803-62-5	>99	SiH_4

4. FIRST AID MEASURES

Eye Contact	Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Call a physician immediately.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Seek immediate medical attention / advice.
Inhalation	PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF INHALATION OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious inhalation victims should be assisted to an uncontaminated area and inhale fresh air. If breathing is difficult, administer oxygen. Unconscious persons should be moved to an uncontaminated area and, as necessary, given artificial resuscitation and supplemental oxygen. Treatment should be symptomatic and supportive.
Ingestion	None under normal use. Get medical attention if symptoms occur.
Notes to Physician	Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flammable Properties	Spontaneously combustible (pyrophoric). May be spontaneously flammable in air. Containers may explode when heated.
Suitable Extinguishing Media	Carbon dioxide (CO_2). Foam. Dry powder. DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.

Unsuitable Extinguishing Media	Do not use halogenated extinguishing agents or foam.
Hazardous Combustion Products	Silicon dioxide.

Explosion Data

Sensitivity to Mechanical Impact	None
Sensitivity to Static Discharge	Yes.
Specific Hazards Arising from the Chemical	Silane is a pyrophoric gas that will generally spontaneously ignite upon contact with air. For spontaneous ignition, however, certain silane concentrations, turbulence, and temperature of the mixture must be satisfied. The greatest hazard of Silane is its unpredictable behavior when released into the air. Continue to cool fire exposed cylinders until flames are extinguished. Cylinders may rupture under extreme heat. Damaged cylinders should be handled only by specialists.
Protective Equipment and Precautions for Firefighters	If possible, stop the flow of gas. Do not extinguish the fire until supply is shut off as otherwise an explosive-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Ventilation fans must be explosion proof. Use non-sparking tools to close container valves. Isolate spill or leak area for at least 100 meters (330 feet) in all directions. Vapors from liquefied gas are initially heavier than air and spread along ground. Vapors may accumulate in confined areas (basement, tanks, hopper / tank cars, etc.). Vapors may travel to source of ignition and flash back. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA / NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Use personal protective equipment. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Releases of Silane into air can produce silicon dioxide.
Environmental Precautions	Prevent spreading of vapors through sewers, ventilation systems and confined areas.
Methods for Containment	Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.
Methods for Cleaning Up	Return cylinder to Linde or an authorized distributor.

7. HANDLING AND STORAGE

Handling

Handle in sealed, purged system. Ground and bond all lines and equipment associated with product system. All equipment should be non-sparking and explosion proof. Remove all sources of ignition. Use only in ventilated areas. "NO SMOKING" signs should be posted in storage and use areas.

Pure silane is non-corrosive and may be handled in most common structural containers. Carbon steel, stainless steel, brass, Monel® & Hasteloy C are most commonly used materials. It 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. Materials may accumulated behind outlet plug. Wear appropriate protective equipmet and face outlet away when removing plug and connecting cylinder.

Never attempt to lift a cylinder by its valve protection cap. Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Use equipment rated for cylinder pressure. Use backflow preventive device in piping.

Use an adjustable strap wrench to remove over-tight or rusted caps. Never insert an object (e.g. wrench, screwdriver, pry bar,etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never attempt to refill a compressed gas cylinder without the owner's written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

For additional recommendations, consult Compressed Gas Association's Pamphlet G-13.

Storage

Outside or detached storage is preferred. Protect from physical damage. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Keep at temperatures below 52°C / 125°F. Full and empty cylinders should be segregrated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Silane 7803-62-5	TWA: 5 ppm	(vacated) TWA: 5 ppm (vacated) TWA: 7 mg / m^3	TWA: 5 ppm TWA: 7 mg / m^3

ACGIH TLV: American Conference of Governmental Industrial Hygienists - Threshold Limit Value. OSHA PEL: Occupational Safety and Health Administration - Permissible Exposure Limits. NIOSH IDLH: Immediately Dangerous to Life or Health.

Other Exposure Guidelines

Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Engineering Measures

Showers. Eyewash stations. Explosion proof ventilation systems. Exhaust gas should be vented to a gas treatment system. Monitor cylinders with hydride monitors to detect leaks and releases along with UV / IR monitors for flame detection.

Ventilation

Use ventilation adequate to keep exposures below recommended exposure limits.

Personal Protective Equipment

Eye / Face Protection	For cylinder handling: safety glasses. For routine use (within 15 feet of Silane system): Safety glasses and face shield. For emergency operations: Fire helmet with faceshield, fire resistant hood.
Skin and Body Protection	Work gloves and safety shoes are recommended when handling cylinders. Wear fire / flame resistant / retardant clothing.
Respiratory Protection	
General Use	No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.
Emergency Use	Use positive pressure airline respirator with escape cylinder or self contained breathing apparatus for oxygen-deficient atmospheres (<19.5%).
Hygiene Measures	For routine system operations: Opening and closing valve or work within 15 ft. (4.6 m) of a Silane system includes the following: hard hat, face shield, safety glasses, leather gloves, fire resistant clothing / coveralls and safety shoes.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Colorless.	Odor	Pungent.
Odor Threshold	No information available	Physical State	Compressed gas
Flash Point	Pyrophoric	Autoignition Temperature	No information available.
Decomposition Temperature	No information available.	Boiling Point / Boiling Range	-112 °C / -170 °F
Freezing Point	-185 °C / -301 °F	Molecular Weight	32.112
Water Solubility	Insoluble, Decomposes slowly on exposure to water	Evaporation Rate	No information available
Vapor Pressure	No data available.	Vapor Density	No data available.
Gas Density	0.0899 lb / ft³ (1.44 kg / m³) @ 0°C	VOC Content (%)	Not applicable.
Specific Vol. @ 21.1°C & 1 atm	12.0 ft³ / lb (0.749 m³ / kg)	Critical Pressure	703 psia (4842 kPa abs)
Flammability Limits in Air			
Upper	96%		
Lower	1.4%		

10. STABILITY AND REACTIVITY

Stability	Silane will ignite spontaneously in air
Incompatible Products	Oxidizing agents. Halogens. Alkalis.
Conditions to Avoid	Heat, flames and sparks. Explosive reaction / ignition on contact with covalent halides or halogens. Ignites on contact with oxygen or air.
Hazardous Decomposition Products	Silicon dioxide. Hydrogen gas. at 788F / 420C.
Hazardous Polymerization	Hazardous polymerization does not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

LD50 Oral:	No information available.
LD50 Dermal:	No information available.

LC50 Inhalation:	Per CGA P-20: 19000 ppm / 1 hr. (Rat)
Inhalation	Toxicological data for silane in the open literature is extremely limited. Four out of ten mice died following inhalation of 9600 ppm for 4 hours. The four hour LC50 value for the rat has been cited as 4000 ppm and 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.
Repeated Dose Toxicity	No information available.

Chronic Toxicity

Chronic Toxicity	None known.
Carcinogenicity	Contains no ingredient listed as a carcinogen.
Irritation	May cause irritation.
Sensitization	No information available.
Reproductive Toxicity	No information available.
Developmental Toxicity	No information available.
Synergistic Materials	None known.
Target Organ Effects	Central nervous system (CNS). Eyes. Respiratory system. Skin.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The environmental impact of this product has not been fully investigated. Will not bioconcentrate.

Ozone depletion potential; ODP; (R-11 = 1): Does not contain ozone depleting chemical (40 CFR Part 82).

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods	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 Linde for proper disposal.

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Silane
Hazard Class	2.1
Subsidiary Class	None

UN-Number	UN2203
Description	UN2203,Silane,2.1
Emergency Response Guide Number	116

TDG

Proper Shipping Name	Silane, compressed
Hazard Class	2.1
UN-Number	UN2203
Description	UN2203,SILANE, COMPRESSED,2.1

MEX

Proper Shipping Name	Silane
Hazard Class	2.1
UN-Number	UN2203
Description	UN2203 Silane,2.1

IATA

UN-Number	UN2203
Proper Shipping Name	Silane
Hazard Class	2.1
ERG Code	10L
Description	UN2203,Silane,2.1
Maximum Quantity for Passenger	Forbidden
Maximum Quantity for Cargo Only	Forbidden
Limited Quantity	No information available.

IMDG / IMO

Proper Shipping Name	Silane
Hazard Class	2.1
UN-Number	UN2203
EmS No.	F-D, S-U
Description	UN2203, Silane,2.1

ADR

Proper Shipping Name	Silane
Hazard Class	2.1
UN-Number	UN2203
Classification Code	2F
Description	UN2203 Silane,2.1,

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL	Complies
EINECS / ELINCS	Complies

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL / NDSL - Canadian Domestic Substances List / Non-Domestic Substances List
EINECS / ELINCS - European Inventory of Existing Commercial Chemical Substances / EU List of Notified Chemical Substances

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311 / 312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	Yes
Sudden Release of Pressure Hazard	Yes
Reactive Hazard	Yes

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Risk and Process Safety Management Programs
This material, as supplied, contains one or more regulated substances with specified thresholds under 40 CFR Part 68 or regulated as a highly hazardous chemical pursuant to the 29 CFR Part 1910.110 with specified thresholds:

Chemical Name	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances	U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
Silane	-	10000 lbs	-

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)
This product does not contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act Amendments of 1990.

CERCLA / SARA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

U.S. State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical Name	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Silane	X	X	X	-	X

International Regulations

Chemical Name	Carcinogen Status	Exposure Limits
Silane	-	Mexico: TWA 5 ppm Mexico: TWA 7 mg / m^3

Canada

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

WHMIS Hazard Class
A Compressed gases
B1 Flammable gas
D2B Toxic materials

Prepared By	Product Stewardship 23 British American Blvd. Latham, NY 12110 1-800-572-6501
Issuing Date	05-Mar-2010
Revision Date	27-Sep-2013
Revision Number	2
Revision Note	Not applicable.

NFPA	Health Hazard 1	Flammability 4	Stability 1	Physical and Chemical Hazards -
HMIS	Health Hazard 0	Flammability 4	Physical Hazard 3	Personal Protection -

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

End of Safety Data Sheet