



SILANE

Safety Data Sheet

1. IDENTIFICATION

Product identifier

Product Name SILANE

Other means of identification

Safety data sheet number LIND-P107

UN/ID no. UN2203

Synonyms Silicon Tetrahydride; Monosilane; Silicane; Silicon Hydride (SiH₄)

Recommended use of the chemical and restrictions on use

Recommended Use Industrial and professional use.

Uses advised against Consumer use

Details of the supplier of the safety data sheet

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.

Road 869, Km 1.8

Barrio Palmas, Catano, PR 00962

Phone: 787-641-7445

www.pr.lindegas.com

Linde Canada Limited

5860 Chedworth Way

Mississauga, Ontario L5R 0A2

Phone: 905-501-1700

www.lindecana.com

* May include subsidiaries or affiliate companies/divisions.

For additional product information contact your local customer service.

Emergency telephone number

Company Phone Number 800-232-4726 (Linde National Operations Center, US)
905-501-0802 (Canada)

CHEMTREC: 1-800-424-9300 (North America) +1-703-527-3887 (International)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Acute toxicity - Inhalation (Gases)	Category 4
Flammable gases	Category 1
Pyrophoric gas	Yes
Gases under pressure	Liquefied gas

Label elements

Signal word

Danger

Hazard Statements

Extremely flammable gas

Catches fire spontaneously if exposed to air

Contains gas under pressure; may explode if heated

Harmful if inhaled

Precautionary Statements - Prevention

Do not handle until all safety precautions have been read and understood

Keep away from heat, sparks, open flames, hot surfaces. — No smoking

Do not allow contact with air

Avoid breathing gas

Use and store only outdoors or in a well ventilated place

Use backflow preventive device in piping

Close valve after each use and when empty

Use only with equipment rated for cylinder pressure

Use only with equipment purged with inert gas or evacuated prior to discharge from cylinder

Do not open valve until connected to equipment prepared for use

When returning cylinder, install leak tight valve outlet cap or plug

Precautionary Statements - Response

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.

Leaking gas fire: do not extinguish, unless leak can be stopped safely

Eliminate all ignition sources if safe to do so

Precautionary Statements - Storage

Protect from sunlight when ambient temperature exceeds 52°C/125°F

Hazards not otherwise classified (HNOC)

Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Volume %	Chemical Formula
Silane	7803-62-5	100	SiH ₄

4. FIRST AID MEASURES

Description of first aid measures

General advice	Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.
Inhalation	Remove to fresh air and keep comfortable for breathing. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration. Get medical attention immediately.
Skin contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention if symptoms occur.
Eye contact	Immediately flush eye with running water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Keep eye wide open while rinsing. Do not rub affected area. Get medical attention if symptoms occur.
Ingestion	Not an expected route of exposure.
Self-protection of the first aider	Remove all sources of ignition. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Most important symptoms and effects, both acute and delayed

Symptoms	Exposure to silane may cause headache and nausea. Irritating to eyes, respiratory system and skin. Ignited gas can cause thermal burns.
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Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.
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5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

Carbon dioxide (CO₂). 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.
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Specific extinguishing methods

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.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Damaged cylinders should be handled only by specialists.

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. Vapors may travel to source of ignition and flash back. Vapors from liquefied gas are initially heavier than air and

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.

Only experienced and properly instructed persons should handle gases under pressure. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

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

Conditions for safe storage, including any incompatibilities

Storage Conditions 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. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Full and empty cylinders should be segregated. Stored containers should be periodically checked for general condition and leakage. Outside or detached storage is preferred.

Incompatible materials Air. Oxidizing agents. Halogens. Alkalis.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

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

Appropriate engineering controls

Engineering Controls 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. Systems under pressure should be regularly checked for leakages.

Individual protection measures, such as 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 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. Take precautionary measures against static discharge. Work gloves and safety shoes are recommended when handling cylinders.

Respiratory protection Use positive pressure airline respirator with escape cylinder or self contained breathing apparatus for oxygen-deficient atmospheres (<19.5%). If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice. Do not get in eyes, on skin, or on clothing. Do not eat, drink or smoke when using this product. Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Gas
Appearance	Colorless.
Odor	Pungent.
Odor threshold	No information available
pH	No data available
Melting point	-185 °C / -301 °F
Evaporation rate	Not applicable
Fire Hazard	Yes
Lower flammability limit:	1.4%
Upper flammability limit:	96%
Flash point	Pyrophoric
Autoignition temperature	<85 °C
Decomposition temperature	No data available
Water solubility	Decomposes slowly on exposure to water
Partition coefficient	No data available
Kinematic viscosity	Not applicable

Chemical Name	Molecular weight	Boiling point	Vapor Pressure	Vapor density (air =1)	Gas Density kg/m ³ @20°C	Critical Temperature
Silane	32.11	-112 °C	Above critical temperature	1.11	1.342	-3.4 °C

10. STABILITY AND REACTIVITY

Reactivity

Not reactive under normal conditions

Chemical stability

Stable under recommended storage and handling conditions (see Section 7).

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	Yes.

Possibility of Hazardous Reactions

Catches fire spontaneously if exposed to air. Explosive reaction/ignition on contact with covalent halides or halogens. May react violently with oxidizers.

Conditions to avoid

Heat, flames and sparks. Ignites on contact with oxygen or air.

Incompatible materials

Air. Oxidizing agents. Halogens. Alkalis.

Hazardous Decomposition Products

Hydrogen gas. Silicon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

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. The hydrolysis of silane in the body tissues

would form silicic acid and hydrated silica. May cause irritation of respiratory tract.

Skin contact Contact may form silicic acid causing irritation.

Eye contact Contact may form silicic acid causing irritation.

Ingestion Not an expected route of exposure.

Information on toxicological effects

Symptoms Exposure to silane may cause headache and nausea. Ignited gas can cause thermal burns.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Not classified.
Irritation	May cause irritation.
Sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	This product does not contain any carcinogens or potential carcinogens listed by OSHA, IARC or NTP.
Reproductive toxicity	Not classified.
STOT - single exposure	Not classified.
STOT - repeated exposure	Not classified.
Chronic toxicity	None known.
Target Organ Effects	Central nervous system, Eyes, Respiratory system, Skin.
Aspiration hazard	Not applicable.

Numerical measures of toxicity

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50	Inhalation LC50 (CGA P-20)
Silane 7803-62-5	-	-	= 9500 ppm (Rat) 4 h	19,000 ppm (Rat) 1hr

Product Information

Oral LD50	No information available
Dermal LD50	No information available
Inhalation LC50	No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

No known acute aquatic toxicity.

Persistence and degradability

Not applicable.

Bioaccumulation

Will not bioconcentrate.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes 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

UN/ID no.	UN2203
Proper shipping name	Silane
Hazard Class	2.1
Description	UN2203, Silane, 2.1
Emergency Response Guide Number	116

TDG

UN/ID no.	UN2203
Proper shipping name	Silane
Hazard Class	2.1
Description	UN2203, Silane, 2.1

MEX

UN/ID no.	UN2203
Proper shipping name	Silane
Hazard Class	2.1
Description	UN2203, Silane, 2.1

IATA

Forbidden

IMDG

UN/ID no.	UN2203
Proper shipping name	Silane
Hazard Class	2.1
EmS-No.	F-D, S-U
Description	UN2203, Silane, 2.1

ADR

UN/ID no.	UN2203
Proper shipping name	Silane
Hazard Class	2.1
Classification code	2F
Tunnel restriction code	(B/D)
Special Provisions	632
Description	UN2203, Silane, 2.1, (B/D)
Labels	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/NDL - Canadian Domestic Substances List/Non-Domestic Substances List

EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances

US Federal RegulationsSARA 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

CERCLA

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.

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.

CWA (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	-

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Silane 7803-62-5	X	X	X

International Regulations

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

16. OTHER INFORMATION

NFPA Health hazards 1 Flammability 4 Instability 1 Physical and Chemical Properties -

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.

Issue Date	24-Mar-2015
Revision Date	24-Mar-2015
Revision Note	Not applicable.

General Disclaimer

For terms and conditions, including limitation of liability, please refer to the purchase agreement in effect between Linde LLC, Linde Merchant Production, Inc. or Linde Gas North America LLC (or any of their affiliates and subsidiaries) and the purchaser.

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End of Safety Data Sheet