



AIR LIQUIDE

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: SILANE

SYNONYMS: Silicon Tetrachloride; Monosilane; Silicane
CHEMICAL FAMILY NAME: Hydride
FORMULA: SiH₄

PRODUCT USE:	Document Number: 20148 Production of amorphous silicon and silicon substrates; other analytical/synthetic chemical uses.
SUPPLIER/MANUFACTURER'S NAME:	AIR LIQUIDE AMERICA CORPORATION
ADDRESS:	2700 Post Oak Drive Houston, TX 77056-8229
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	General MSDS Information 1-713/868-0440 Fax on Demand: 1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					OTHER
			ACGIH		OSHA			
			TLV ppm	STEL ppm	PEL ppm	STEL ppm	IDLH ppm	
Silane	7803-62-5	> 99%	5	NE	5 (Weighted 1000 PEL)	NE	NE	NIOSH REL: 5 ppm
Maximum Impurities		< 1%	None of the trace impurities in this product contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established

C = Ceiling Limit

See Section 18 for Definitions of Terms Used.

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

EFFECTIVE DATE: MAY 1, 1997

SILANE - SiH₄ MSDS

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FROM: AIR LIQUIDE

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: PYROPHORIC GAS! This product is a colorless, air-reactive gas, with a choking effect. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide. Silane can react with water to form corrosive silicic acid. The primary health hazard associated with Silane is the potential for severe thermal burns from contact with flames resulting from the spontaneous ignition of this gas. Depending on the severity of the burns, such exposures can be fatal. Flame or high temperature impinging on a localized area of the cylinder of this product can cause the cylinder to burst without activating the cylinder's relief devices. If Silane is released at high pressure or high flow velocity, a delayed detonation may occur. Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached. Emergency responders must have personal protective equipment and fire protection appropriate for the situation to which they are responding.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The gas is pyrophoric; over-exposures to the unignited gas would be unlikely under normal circumstances of use. The following symptoms may develop in the event of over-exposure to Silane and its decomposition products:

INHALATION: Inhalation of high concentrations of this gas can result in headache, nausea, dizziness, and irritation of the upper respiratory tract. Silane reacts with water to form silicic acid, which can be irritating to the mucous membranes and the respiratory system. Severe Silane over-exposures via inhalation may result in pulmonary edema. Decomposition of Silane will result in the production of amorphous silicon dioxide. Though inhalation of amorphous silicon dioxide can be irritating to the nose and throat, such exposure does not present the potential for adverse health effects as inhalation of crystalline silicon dioxide.

SKIN and EYE CONTACT: Silane reacts with water to form silicic acid, which can be irritating to the skin and eyes. Decomposition of Silane will result in the production of amorphous silicon dioxide. Skin or eye contact with particulates of amorphous silicon dioxide may be irritating.

OTHER POTENTIAL HEALTH EFFECTS: The chief health hazard presented by Silane is that it ignites so rapidly, personnel in the area of a release can receive severe thermal burns. Depending on the severity of the burns, such exposures can be fatal.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to Silane may cause the following health effects:

ACUTE: The primary health hazard associated with Silane is the potential for severe thermal burns from contact with flames which result from the spontaneous ignition of this gas. Though unlikely to occur under normal circumstances, inhalation of high concentrations of Silane can cause headache, nausea, and irritation of the upper respiratory tract. Reaction of Silane with air or moisture can produce silicic acid and amorphous silicon dioxide; both decomposition products can irritate the eyes, mucous membranes and respiratory tract.

CHRONIC: No chronic health effect is currently associated with exposures to Silane.

TARGET ORGANS: Respiratory system, skin, eyes.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH	(BLUE)	1	
FLAMMABILITY	(RED)	4	
REACTIVITY	(YELLOW)	3	
PROTECTIVE EQUIPMENT			X
EYES	RESPIRATORY	HANDS	BODY
See Section 8			
For routine industrial applications			

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant equipment should be worn. Adequate fire protection must be provided during rescue situations.

NOTE: Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached!

4. FIRST-AID MEASURES (Continued)

Remove victim(s) to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary.

THERMAL BURNS: In the event personnel are burned as a result of a Silane release, trained personnel should provide first aid treatment. Get medical attention immediately.

SKIN EXPOSURE: If silicic acid (from the reaction of Silane and water) contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. If amorphous silicon dioxide (from the reaction of Silane with oxygen) contaminates the skin, flush area with copious amounts of water. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek medical attention if irritation persists, or if there are other adverse health effects.

EYE EXPOSURE: If the decomposition products (silicic acid, amorphous silicon dioxide) contaminate the eyes, immediately begin decontamination with running water, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek medical attention.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

FLASH POINT (method): Not applicable. Pyrophoric gas.

AUTOIGNITION TEMPERATURE: Not applicable. Pyrophoric gas.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 1.4%

Upper (UEL): 96%

FIRE EXTINGUISHING MATERIALS: Extinguish Silane fires by shutting-off the source of the gas. Use a fine water spray or fog to reduce combustion products formed in air. Do not use halocarbon-type fire extinguishing agents. Cool fire-exposed cylinders with water spray, from the maximum distance possible.

UNUSUAL FIRE AND EXPLOSION HAZARDS: PYROPHORIC GAS! This product is a colorless, air-reactive gas. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide. The products of thermal decomposition of this material include amorphous silicon dioxide and hydrogen. Silane can react with water to form corrosive silicic acid. The decomposition products of Silane can be irritating to exposed tissue. If Silane is released at high pressure or high flow velocity, a **delayed detonation may occur**. Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached.

DANGER! Fires impinging (direct flame) on the outside surface of unprotected cylinders of this product can be very dangerous. Exposure to fire could cause a catastrophic failure of the cylinder releasing the contents into a fireball and explosion of released gas. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

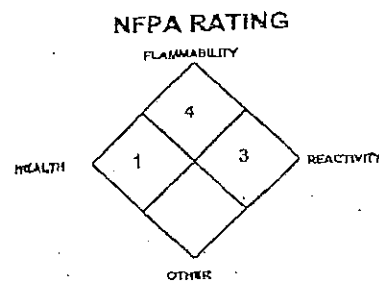
Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Static discharge may cause this product to ignite explosively.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. If water is not available for cooling or protection of cylinder exposures, evacuate the area. Follow the evacuation guidelines of the North American Emergency Response Guidebook (Guide #116).

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Evacuate Immediate area. Silane is a pyrophoric gas and can ignite spontaneously upon contact with air. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Normally, an accidental release of Silane will result in a fire. If Silane is released at high pressure or high flow velocity, a delayed detonation may occur. Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide.



6. ACCIDENTAL RELEASE MEASURES

Proper protective equipment should be used. In case of a gas release, clear the affected area, protect people, and respond with trained personnel.

Eliminate any possible sources of ignition, and provide maximum explosion-proof ventilation. If the gas is leaking from cylinder or valve, contact the supplier. Adequate fire protection must be provided. Use only non-sparking tools and equipment during the response.

Minimum Personal Protective Equipment should be Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus. Use only non-sparking tools and equipment. Locate and seal the source of the leaking gas. Protect personnel attempting the shut-off with water-spray. Allow the gas to dissipate.

Monitor the surrounding area for combustible gas levels. The level of Silane must be at acceptable levels (see Section 2, Composition or Information on Ingredients) before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Combustible gas concentration must be below 10% of the LEL (1.4%) prior to entry. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

THIS IS A PYROPHORIC GAS. Protection of all personnel and the area must be maintained.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Non-sparking tools should be used. Do not attempt to repair, adjust, or in any other way modify the cylinders containing Silane.

If there is a malfunction, or another type of operational problem, contact nearest distributor immediately. Working alone with Silane should be avoided when possible. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release.

STORAGE AND HANDLING PRACTICES: Cylinders should be stored upright (with valve-protection cap in place) and firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Cylinders should be stored in dry, well-ventilated areas away from sources of heat, ignition and direct sunlight.

Keep storage area clear of materials which can burn. Do not allow area where cylinders are stored to exceed 52°C (125°F). Store containers away from heavily trafficked areas and emergency exits. Store away from process and production areas, away from elevators, building and room exits or main aisles leading to exits. Protect cylinders against physical damage. Because of the potential for delayed ignition of Silane, storage and use areas should be designed and constructed to protect workers from possible explosive detonation.

Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals, such as strong oxidizers, metals, and metal oxides (refer to Section 10, Stability and Reactivity, for more information).

Storage areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs in storage or use areas. Consider installation of leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment in the storage area (i.e. sprinkler system, portable fire extinguishers).

Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time.

Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion proof. Use a check valve in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders.

SPECIAL HANDLING PROCEDURES FOR HANDLING SILANE:

- Do not condense Silane by avoiding temperatures of -148°F (-100°C) or less. Condensation of Silane runs the risk of leaks developing and forming explosive mixtures (due to sucking-back of air into the system).
- Do not use Silane in conjunction with heavy-metal halides or free halogens, with which Silane will react violently. Care should be taken that all handling systems are purged free of halogens that might exist from degreasing agents, or chlorinated hydrocarbons.

7. HANDLING and USE (Continued)

- Evacuate and thoroughly pressure-check all systems, preferably with helium, for leaks at pressures two to three times the anticipated working pressure. In addition, regular leak-testing should be instituted and performed.
- Use an alternate vacuum and inert gas purge cycles of the system to purge all air out of the system after it has been leak-tested or opened for any reason.
- Before disconnecting any system that has Silane in it, thoroughly purge the system of Silane with an inert gas. Any portion of a system that is dead-ended or allows "pocketing" of Silane should be treated with considerable vacuum-purge cycles.
- Vent Silane or Silane mixtures through small-diameter pipe or tubing ending under a shallow seal to prevent back diffusion of air. Venting should be to an area designed for Silane disposal, preferably by burning. Concentrations, even in the low percentage range, are dangerous and should not be exposed to air. Silane can also be vented by diluting with an inert gas to prevent ignition upon discharge to the atmosphere.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Compressed gases can present significant safety hazards. The following rules are applicable to work situations in which cylinders are being used:

Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap (where provided) in-place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Use piping and equipment adequately designed to withstand pressures to be encountered. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Do not use oils or grease on gas-handling fittings or equipment. Do not "crack" valve open before connecting it, since self-ignition may occur. Leak check system with leak detection solution or other leak detection instruments suitable for Silane, never with flame. Immediately contact the supplier if there are any difficulties associated with operating cylinder valve. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc on a compressed gas cylinder or make a cylinder part of an electric circuit.

After Use: Close main cylinder valve. Valves should be closed tightly. Replace valve protection cap. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers designed for flammable gas storage. Earth-ground and bond all lines and equipment associated with this product. Close valve after each use and when empty.

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA: Use the proper connections, **DO NOT USE ADAPTERS.**

THREADED: Up to 500 psig - CGA 510
Up to 3000 psig - CGA 350

PIN-INDEXED YOKE: Not Applicable.

ULTRA HIGH INTEGRITY: Up to 3000 psig - CGA 632.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (i.e. nitrogen) before attempting repairs. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Silane detectors should be installed in or near areas where this product is being used or stored. If appropriate, install automatic monitoring equipment to detect the level of oxygen and the presence of potentially explosive air-gas mixtures. Use with adequate ventilation. Provide natural or explosion-proof ventilation adequate to ensure Silane does not reach its lower flammability limit of 1.4%. Local exhaust ventilation is preferred, because it prevents gas dispersion into the work place by eliminating it at its source.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen levels are below 19.5% or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards.

EFFECTIVE DATE: MAY 1, 1997

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8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

EYE PROTECTION: Safety glasses.

HAND PROTECTION: Wear leather gloves when handling cylinders of this product.

BODY PROTECTION: Use body protection appropriate for task. Cotton clothing is recommended for use to prevent static electric build-up. Safety shoes are recommended when handling cylinders. Fire retardant clothing may be appropriate under some circumstances of use.

9. PHYSICAL and CHEMICAL PROPERTIES

GAS DENSITY @ 32°F (0°C): 0.0899 lb/ft³ (1.44 kg/m³)

BOILING POINT @ 1 atm: -169°F (-112°C)

FREEZING/MELTING POINT @ 1 atm: -300.5°F (-184.7°C)

SPECIFIC GRAVITY @ 70°F (21.1°C) and 14.7 psia (air = 1): 1.2

SOLUBILITY IN WATER @ 68°F (20°C): Negligible.

EVAPORATION RATE (nBuAc = 1): Not applicable.

ODOR THRESHOLD: Not determined.

VAPOR PRESSURE @ -188°F (-122.2°C) psig: 7.73

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

APPEARANCE AND COLOR: Colorless gas, with a choking effect.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor cannot be considered a good warning property, because; the odor threshold is above the level necessary for the ignition of Silane. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide.

pH: Not applicable.

MOLECULAR WEIGHT: 32.112

EXPANSION RATIO: Not applicable.

SPECIFIC VOLUME (ft³/lb): 12.0

10. STABILITY and REACTIVITY

STABILITY: Pyrophoric. Ignites spontaneously on exposure to air.

DECOMPOSITION PRODUCTS: Amorphous silicon dioxide and hydrogen.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Silane will react violently with heavy-metal halides and free halogens (i.e. bromine, chlorine, carbonyl chloride, antimony pentachloride, tin[IV] chloride). Silane ignites in oxygen and can react with other oxidizers. Silane is also incompatible with bases.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with air. Contact with incompatible materials and exposure to heat, sparks and other sources of ignition. If the cylinders are exposed to extremely high temperatures, these cylinders can rupture.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicity data are available for Silane.

Inhalation - Rat: LC₅₀: 9600 ppm/4 hours
Inhalation - Mouse: LCLo: 9600 ppm/4 hours

SUSPECTED CANCER AGENT: Silane is not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: This decomposition products of Silane are irritating to the eyes, skin, and tissues of the respiratory system.

SENSITIZATION TO THE PRODUCT: Silane is not known to be a sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this product on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for Silane.

Embryotoxicity: No embryotoxic effects have been described for Silane.

Teratogenicity: No teratogenicity effects have been described for Silane.

Reproductive Toxicity: No reproductive toxicity effects have been described for Silane.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

11. TOXICOLOGICAL INFORMATION (Continued)

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Skin conditions and respiratory disorders may be aggravated by exposures to Silane and its decomposition products.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary; treat symptoms; eliminate exposure. Be observant for initial signs of pulmonary edema.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Silane.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Silane ignites spontaneously upon contact with air, generating amorphous silicon dioxide and hydrogen. Silane, upon contact with water or moisture, will generate silicic acid. All work practices must be directed at eliminating environmental contamination.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: The primary health hazard associated with Silane is the potential for severe thermal burns to plants and animals from contact with flames which result from the spontaneous ignition of this gas. Depending on the severity of the burns, such exposures can be fatal.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Silane, upon contact with water or moisture, will generate silicic acid. Silicic acid can lower the pH of water; subsequently, releases of Silane can have an adverse effect on aquatic life in contaminated bodies of water.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Air Liquide. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Silane
HAZARD CLASS NUMBER and DESCRIPTION: 2.1
UN IDENTIFICATION NUMBER: UN 2203
PACKING GROUP: Not applicable.
DOT LABEL(S) REQUIRED: Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 116

MARINE POLLUTANT: Silane is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles present serious safety hazards and should be discouraged.

NOTE: Shipment of compressed gas cylinders which have not been filled with the owners consent is a violation of Federal law (49 CFR, Part 173.301 (b)).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: This product is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPOUND	SARA 302	SARA 304	SARA 313
Silane	NO	NO	NO

SARA Threshold Planning Quantity: Not applicable.

TSCA INVENTORY STATUS: Silane is listed on the TSCA Inventory.

CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS:

- Silane is not subject to the reporting requirements of CFR 29 1910.1000.

EFFECTIVE DATE: MAY 1, 1997

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15. REGULATORY INFORMATION (Continued)

- Depending on specific operations involving the use of Silane, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Silane is not listed in Appendix A of this regulation, however, any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lbs (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.
- Silane does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82).
- Silane is listed under Table 3 as a Regulated Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Release Prevention, as a flammable substance. The threshold quantity for Silane under this regulation is 10,000 lbs.
- Silane is listed under Section 112(r) of the Clean Air Act. The threshold quantity for Silane under this regulation is 10,000 lbs.

OTHER CANADIAN REGULATIONS: Silane is categorized as a Controlled Product, Hazard Classes A, B1, B6, and F as per the Controlled Product Regulations.

STATE REGULATORY INFORMATION: Silane covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Silane.

California - Permissible Exposure Limits for Chemical Contaminants: Silane.

Florida - Substance List: Silane.

Illinois - Toxic Substance List: Silane.

Kansas - Section 302/313 List: None.

Massachusetts - Substance List: Silane.

Minnesota - List of Hazardous Substances: Silane.

Missouri - Employer Information/Toxic Substance List: Silane.

New Jersey - Right to Know Hazardous Substance List: Silane.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: None.

Pennsylvania - Hazardous Substance List: Silane.

Rhode Island - Hazardous Substance List: Methylene Chloride, Carbon Dioxide.

Texas - Hazardous Substance List: Silane.

West Virginia - Hazardous Substance List: None.

Wisconsin - Toxic and Hazardous Substances: None.

CALIFORNIA PROPOSITION 65: Silane is not on the California Proposition 65 lists.

16. OTHER INFORMATION

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

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"Safe Handling of Compressed Gases in Containers"

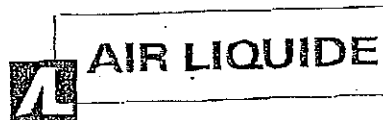
"Safe Handling and Storage of Compressed Gases"

"Handbook of Compressed Gases"

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
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Fax on Demand: 1-800/231-1366



This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide America Corporation's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

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EFFECTIVE DATE: MAY 1, 1997

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