MATERIAL SAFETY DATA SHEET

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

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: **DEUTERATED SILANE**
CHEMICAL NAME: Deuterated Silicon Hydride
FORMULA: SiD_4
SYNONYMS: Silicon Deuteride; Monosilane, Deuterated
SUPPLIER ADDRESS: Linde Gas North America LLC
575 Mountain Ave.
Murray Hill, NJ 07974
PHONE: 908/464-8100
WEB SITE: www.lindeus.com
24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 703-527-3887 outside of US
DATE OF REVISION: March 9, 2011
MSDS NUMBER: 1047
PRODUCT USE: Various

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Silane (deuterated)

CAS NUMBER: 13537-07-0
EINECS NUMBER: 232-263-4
EXPOSURE LIMITS: (10,000 ppm = 1%)

OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
TWA = 5 ppm (1989 Vacated PEL)	TWA = 5 ppm	TWA = 5 ppm

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: DANGER PYROPHORIC GAS!!! Deuterated Silane is a colorless, pyrophoric gas, with a choking effect, which is shipped under pressure. This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide. Deuterated Silane can react with water to form corrosive silicic acid. The primary health hazard associated with Deuterated 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 Deuterated Silane is released at high pressure or high flow velocity, a delayed detonation may occur. Deuterated Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached. **Deuterated Silane is an extremely dangerous, pyrophoric gas. Deuterated Silane may cause serious burns, fires and explosions if mishandled. Deuterated Silane should only be handled by appropriately trained personnel. Please read the rest of this Material Safety Data Sheet carefully before handling this material.**

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: DANGER! Deuterated Silane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached! If rescue personnel need to enter an area in which a release of Deuterated Silane has occurred, they should be equipped with Self-Contained Breathing Apparatus (SCBA) and fire-protective gear. Releases of this gas create an fire extreme hazard. Acute overexposure to this gas may cause the following health effects:

EYE CONTACT: Decomposition of Deuterated Silane will result in the production of amorphous silicon dioxide. Eye contact with particulates of amorphous silicon dioxide may be irritating. Depending on duration of contact, symptoms can include burning, itching, redness, swelling and excessive tearing. Serious overexposure to the eyes can result in burns from the silicic acid which forms upon contact with moisture in the eye. Release of a high-pressure gas may result in airborne objects.

INGESTION: Ingestion of this gas is not a likely route of industrial exposure.

SECTION 3. HAZARD IDENTIFICATION (Continued)

INHALATION: Inhalation of high concentrations of this gas can result in headache, nausea, dizziness, and irritation of the upper respiratory tract. Deuterated Silane reacts with water to form silicic acid, which can be irritating to the mucous membranes and the respiratory system. Severe Deuterated Silane over-exposures via inhalation may result in pulmonary edema. Decomposition of Deuterated 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 CONTACT: Deuterated Silane reacts with water to form silicic acid, which can be irritating to the skin. Decomposition of Deuterated Silane will result in the production of amorphous silicon dioxide. Skin contact with particulates of amorphous silicon dioxide may be irritating.

OTHER HEALTH EFFECTS: The chief health hazard presented by Deuterated 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.

HMIS RATINGS: HEALTH HAZARD: = 1; FLAMMABILITY HAZARD: = 4; PHYSICAL HAZARD: = 3;

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Not Applicable
TARGET ORGANS: None.
SYMPTOMS: None.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing respiratory conditions may be affected by low level exposure to the decomposition products of Deuterated Silane (amorphous silicon dioxide).

CARCINOGENICITY: Deuterated Silane is not found on the FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or IARC Carcinogenicity lists and therefore is neither considered to be nor suspected to be a cancer-causing agent by these agencies.

SECTION 4. FIRST AID MEASURES

THERMAL BURNS: In the event personnel are burned as a result of a Disilane release, if burns are first degree or second degree with closed blisters, flush area with cold water until pain subsides. Apply loose, moist, sterile dressings, and bandage. Treat for shock. If burns are second degree with open blisters or third degree, apply loose, dry, sterile dressings and bandage. Treat for shock. Transport victim immediately to hospital or emergency center. Burns over an area of 20% or more of body are life-threatening, medical attention should be immediately sought.

EYE CONTACT: 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. If mechanical injury occurs, cover eye with bandage and seek appropriate medical attention.

INGESTION: Ingestion is an unlikely route of exposure for this gas.

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

SKIN CONTACT: If silicic acid (from the reaction of Deuterated 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 Deuterated 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.

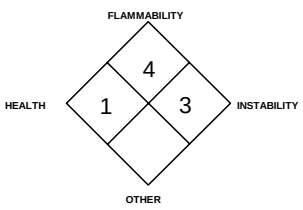
NOTES TO PHYSICIANS: Administer oxygen, if necessary, and treat symptoms. Be observant for initial signs of pulmonary edema.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not applicable. Pyrophoric gas.
AUTOIGNITION: Not applicable. Pyrophoric gas.
FLAMMABLE RANGE: Lower (LEL): 1.0%; Upper (UEL): 96.0-100.0%
NFPA RATINGS:
HEALTH: = 1 FLAMMABILITY: = 4
INSTABILITY: = 3 SPECIAL: None

EXTINGUISHING MEDIA: Extinguish Deuterated 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.

NFPA RATING



See Section 16 for Definition of Ratings

SECTION 5. FIRE FIGHTING MEASURES (Continued)

SPECIAL FIRE-FIGHTING PROCEDURES: Deuterated Silane cylinders, whether actively involved in the fire or not, pose a significant explosion hazard. If cylinders are not leaking, and are not in the area of a fire, effort to remove them from the area should be attempted, if it does not endanger personnel. If this is not possible, keep cylinders cool with a water spray to ensure that they do not rupture. If the cylinder is leaking, or if involved in the fire, attempt to stop the flow of gas, if it can be done safely, cool with a fine water spray, and fight fire from the maximum distance possible. Do not attempt to remove cylinders unless it can be done quickly and safely. If cylinder cannot be removed, evacuate area.

UNUSUAL FIRE AND EXPLOSION HAZARDS: PYROPHORIC GAS! An extreme explosion hazard exists in areas in which the gas has been released, but the material has not yet ignited. 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. Deuterated Silane can react with water to form corrosive silicic acid. The decomposition products of Deuterated Silane can be irritating to exposed tissue. **If Deuterated Silane is released at high pressure or high flow velocity, a delayed detonation may occur. Deuterated 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 Deuterated Silane 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 ensuring explosion (and possible fireball) and can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive 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 gas to ignite explosively.
HAZARDOUS COMBUSTION PRODUCTS: Amorphous silicon dioxide is produced upon exposure to air. When amorphous silicon dioxide is heated to extreme temperatures as may be encountered in a fire, hazardous forms of crystalline silicon dioxide are formed.

SECTION 6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: In the event of a leak of this product, operator should close the gas source if possible to do so safely. Evacuate area in the event of a significant release. The North American Emergency Response Guidebook (Guide #115) recommends 0.5 miles.

Only trained incident-response personnel may re-enter a contaminated area. **Deuterated Silane is a pyrophoric gas.** Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus.** Locate and seal the source of the leaking gas, if competent fire-fighting authority determines that this can be done safely. If the flow of pyrophoric gas cannot be stopped, allow entire cylinder contents to burn.

If this gas leaks without igniting, extreme caution must be used; flammable or explosive mixtures with air may be formed. Allow the gas, which is heavier than air, to dissipate.

Combustible gas concentration must be below 10% of the LEL (1.0%) prior to entry without fire risk. Deuterated Silane levels should be reduced below the exposure limits for standard working conditions (see Section 2, Composition and Information on Ingredients) before workers re-enter the area.

If leak is in user's gas handling equipment or system, close cylinder valve, and safely vent high pressure before attempting repairs. If leak is from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

SECTION 7. HANDLING AND STORAGE

STORAGE: Locations where Deuterated Silane is used or stored should be well-ventilated and located away from other work areas and populated buildings. Low level leaks of Silane may accumulate for some time before igniting without warning, possibly with explosive force. Storage areas should be designed and built to withstand possible emergencies. Areas in which Deuterated Silane is used or stored should be equipped with Deuterated Silane detectors. Detectors indicate whether a leak has occurred so that it can be brought under control immediately before dangerous levels can accumulate. Cylinders of Deuterated Silane should be equipped with flow-restricting orifices.

Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body).

SECTION 7. HANDLING AND STORAGE (Continued)

STORAGE (continued): Cylinders should be stored upright (with valve protection caps and plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. Consideration should be taken to install leak detection and alarm equipment for storage areas. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

Storage and use areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs. Have appropriate extinguishing equipment (i.e. sprinkler system, portable fire extinguishers). 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.

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 (refer to Section 10, Stability and Reactivity).

HANDLING: Releases of Deuterated Silane are extremely dangerous, as this gas is pyrophoric and can ignite spontaneously. Fire blanket should be stored in or very near the work area. Wearing contact lenses is not recommended when handling this gas.

When removing the valve plug, personnel should wear fire-resistant gloves. The cylinder valve should be securely closed. The plug should oriented away from worker's body and removed slowly; if there is any Deuterated Silane trapped behind the plug, it may ignite as the plug is loosened.

All equipment used to handle Deuterated Silane must be free of any type of halogen or halogen-containing compounds. Deuterated Silane reacts violently with even trace amounts of these compounds (including certain types of degreasing agents). Stainless steel and iron are the recommended materials for regulators and piping. When working with Deuterated Silane, a pressure-reducing regulator, equipped with a metal diaphragm to lower pressure to a safe working level, should be used. Valves should be diaphragm packless with Teflon seats. Systems should be equipped with isolation valves and check valves to prevent hazardous backflow. Systems should be designed with minimal dead space so that purging can be done efficiently.

Before introducing Deuterated Silane, systems should be leak-checked (above working pressure) and thoroughly purged with an inert gas to remove air. Residual Deuterated Silane should be purged from the system after use and properly vented. Never purge Deuterated Silane through a vacuum pump.

Deuterated Silane is a pyrophoric gas, thus on contact with air it ignites. If systems are not thoroughly purged, there is a danger of explosion. Solid by-products of combustion can clog and contaminate cylinder orifices, piping, regulators and instrumentation.

Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage or open the valve. Use an adjustable strap-wrench to remove over-tight or rusted caps. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never tamper with pressure relief devices in valves and cylinders. Close valve after each use and when empty.

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

Only trained, experienced personnel should handle this gas.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Relieve pressure before attempting repairs. Follow all cautionary procedures described above during maintenance operations.

SPECIAL PRECAUTIONS: All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers.* Local regulations may require specific equipment for storage and use.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Deuterated 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. Forced explosion-proof ventilation systems for the general work area should be provided to ensure Deuterated Silane does not approach its lower flammability limit of 1% or 5 ppm of Deuterated Silane (the TWA of Deuterated Silane). Deuterated Silane should not be vented into hoods or large volume venting systems, where the danger of explosion is high. Use small diameter vent piping ending in a shallow water seal to prevent back diffusion to air. Pure Deuterated Silane should be vented to an area designed for Deuterated Silane disposal (flare stack, pilot flame, etc.). Contact manufacturer for specific details. Do not vent pure Deuterated Silane to the outdoors. All ventilation equipment must be non-sparking and electrically grounded.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen level is below 19.5% or 5 ppm of Deuterated Silane (the TWA of Deuterated Silane), or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards, standards of Canada, the European Standard EN166, and EC member states.

EYE PROTECTION: Use approved safety goggles or safety glasses, as described in OSHA 29 CFR 1910.133 or by the European Standard EN166. Eyewash stations should be available in areas where Deuterated Silane is used.

SKIN PROTECTION: Work (such as leather) gloves are recommended when handling cylinders of this gas. Wear gloves appropriate to the specific operation for which Deuterated Silane is used. Use triple gloves for spill response. Safety showers should be in areas where Deuterated Silane is used.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. Cotton or Nomex clothing is recommended to prevent static build-up. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require fire-retardant clothing.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

MOLECULAR WEIGHT: 36.15
GAS DENSITY 0°C (32°F): 0.0899 lb/ft^3 (1.44 kg/m^3)
BOILING POINT @ 1 atm: -112°C (-169°F)
FREEZING/MELTING POINT @ 1 atm: -184.7°C (-300.5°F)
SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 1.2
SOLUBILITY IN WATER vol/vol at 20°C (68°F) and 1 atm: Negligible.
SPECIFIC VOLUME @ 21.1°C (70°F): 12.0 lb/ft^3 (0.749 m^3/kg)
CRITICAL PRESSURE: 703 psia (4842 kPa abs)
VAPOR PRESSURE @ -122°C (-187.6°F): 7.73 psig
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.
ODOR THRESHOLD: Not determined.
APPEARANCE, ODOR AND STATE: Colorless, with a choking effect.
WARNING PROPERTIES FOR THIS GAS: This gas usually ignites upon contact with air, releasing a dense white cloud of amorphous silicon dioxide.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Pyrophoric. Ignites spontaneously on exposure to air.
CONDITIONS TO AVOID: Cylinders should not be exposed to temperatures in excess of 125°F (52°C).
MATERIALS WITH WHICH GAS IS INCOMPATIBLE: Deuterated Silane will react violently with heavy-metal halides and free halogens (i.e. bromine, chlorine, carbonyl chloride, antimony pentachloride, tin[IV] chloride). Deuterated Silane ignites in oxygen and can react with other oxidizers. Deuterated Silane is also incompatible with bases.
REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Amorphous silicon dioxide and hydrogen.
B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following are toxicology data for Silane.

Inhalation-Rat LC_{50}: 9600 ppm/4 hours
Inhalation-Mouse LCLo: 9600 ppm/4 hours
Mutation in microorganisms-Salmonella typhimurium: 1 pph

CARCINOGENCITY: Deuterated Silane has not been found to be carcinogenic.

SECTION 11. TOXICOLOGICAL INFORMATION (Continued)

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

SENSITIZATION OF PRODUCT: Deuterated Silane is not a sensitizer.

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

Mutagenicity: Deuterated Silane has not been found to cause mutagenic effects in humans. Mutation data are available on microorganisms exposed to high levels of Silane.
Embryotoxicity: Deuterated Silane has not been found to cause embryotoxic effects in humans.
Teratogenicity: Deuterated Silane has not been found to cause teratogenic effects in humans.
Reproductive Toxicity: Deuterated Silane has not been found to cause adverse reproductive effects in humans.

A mutagen is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical that 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 that causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance that interferes in any way with the reproductive process.

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

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Deuterated Silane ignites spontaneously upon contact with air, generating amorphous silicon dioxide and hydrogen. Deuterated 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 Deuterated 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: Deuterated Silane, upon contact with water or moisture, will generate silicic acid. Silicic acid can lower the pH of water; subsequently, releases of Deuterated Silane can have an adverse effect on aquatic life in contaminated bodies of water.
MOBILITY: Deuterated Silane does not present a hazard of mobility.
PERSISTENCE AND BIODEGRADABILITY: Persistence: Deuterated Silane presents no hazard of persistence. Biodegradation: Deuterated Silane is fully biodegradable.
POTENTIAL TO BIOACCUMULATE: Deuterated Silane will not bioaccumulate.
OZONE-DEPLETION POTENTIAL: Deuterated Silane is not a Class I or Class II ozone depleting chemical (40 CFR Part 82).

SECTION 13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER: Do not dispose of residual product. Return residual product in cylinders to: Linde Electronics & Specialty Gases, 80 Industrial Drive, Alpha, NJ 08865 or Linde Electronics & Specialty Gases, 1261 Activity Drive, Vista, CA 92083.
DISPOSAL INFORMATION: Residual product in user's system may be incinerated. This shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EC member states.

SECTION 14. TRANSPORT INFORMATION

U.S. SHIPPING INFORMATION:

U.S. DOT PROPER SHIPPING NAME:	Silane (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION:	2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 2203
U.S. DOT SHIPPING LABEL(S) REQUIRED:	Class 2.1 (Flammable Gas)
PLACARD (When required):	Flammable

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position in a well-ventilated truck (never transport in passenger compartment of a vehicle). Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.
CAUTION: Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).
NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #: 116

SECTION 14. TRANSPORT INFORMATION (Continued)

CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada. The use of the above U.S. DOT information from the U.S. 49 CFR regulations is allowed for shipments that originate in the U.S. For shipments via ground vehicle or rail that originate in Canada, the following information is applicable.

U.S. DOT PROPER SHIPPING NAME: Silane (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 2203
PACKING GROUP: Not Applicable
HAZARD SHIPPING LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
SPECIAL PROVISIONS: 38
EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX: 0.125
ERAP INDEX: 25
PASSENGER CARRYING SHIP INDEX: Forbidden
PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX: Forbidden

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):

IATA DESIGNATION: This gas is considered as dangerous goods, per the International Air Transport Association.

PROPER SHIPPING NAME: Silane (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 2203
HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)

The following Packaging Information is applicable to this product:

PASSENGER AND CARGO AIRCRAFT				CARGO AIRCRAFT ONLY	
Limited Quantity					
Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg
/////	/////	Forbidden		Forbidden	

NOTE A2: Under IATA regulations, Compressed Silane can only be shipped on passenger aircraft with the prior approval of appropriate authorities of the State of origin under the written conditions established by that authority. A copy of the document of approval, showing the quantity limitations and packing requirements, must accompany the consignment. The commodity may carried on cargo aircraft in accordance with other provisions of IATA for the compound.

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

IMO DESIGNATION: This gas is considered as dangerous goods, per the International Maritime Organization.

PROPER SHIPPING NAME: Silane, compressed (Deuterated Silane)
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 2203
HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
SPECIAL PROVISIONS: None
LIMITED QUANTITIES: None
EmS: F-D, S-U
STOWAGE CATEGORY: Category E - Clear of living quarters. "Separated from" bromine and chlorine.
MARINE POLLUTANT: Silane is not designated by the IMO to be a Marine Pollutant.

EUROPEAN SHIPPING INFORMATION:

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This gas is considered by the Economic Commission for Europe to be dangerous goods. Additional information is as follows:

UN NUMBER: 2203
NAME and DESCRIPTION: Silane (deuterated silane)
CLASS: 2
CLASSIFICATION CODE: 2F
PACKING GROUP: Not Applicable
LABELS: 2.1
SPECIAL PROVISIONS: 632
LIMITED QUANTITIES: LQ0
PACKING INSTRUCTIONS: P200
MIXED PACKING INSTRUCTIONS: MP9
HAZARD IDENTIFICATION NUMBER: 23

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:

EPA - ENVIRONMENTAL PROTECTION AGENCY:

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (40 CFR Parts 117 and 302)

Reportable Quantity (RQ): Not Applicable

SARA TITLE III: Superfund Amendment and Reauthorization Act

SECTIONS 302/304: Emergency Planning and Notification (40 CFR Part 355)

Extremely Hazardous Substances: Silane is not listed.
Threshold Planning Quantity (TPQ): Not Applicable
Reportable Quantity (RQ): Not Applicable

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: No
DELAYED HEALTH: No
PRESSURE: Yes
REACTIVITY: No
FIRE: Yes

SECTION 313: Toxic Chemical Release Reporting (40 CFR 372)

Releases of Silane do not require reporting under Section 313.

CLEAN AIR ACT:

SECTION 112 (r): Risk Management Programs for Chemical Accidental Release (40 CFR Part 68)

Threshold Planning Quantity (TPQ): 10,000 lbs (4,553 kg)

TSCA: Toxic Substances Control Act

Not listed on the TSCA Inventory. May be used under R&D exemption.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119: Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): 10,000 lbs (4,553 kg) [for all flammable gases, unless it is used as fuel]

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: Deuterated Silane is not a listed substance which the State of California requires warning under this statute.

Silane is listed by the following State regulations (more specific regulations exist in some States):

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:. No.
Massachusetts - Substance List: Silane.
Michigan - Critical Materials Register: No.
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: No.
Pennsylvania - Hazardous Substance List: Silane.
Rhode Island - Hazardous Substance List: No.
Texas - Hazardous Substance List: Silane.
West Virginia - Hazardous Substance List: No.
Wisconsin - Toxic and Hazardous Substances: No.

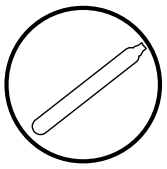
CANADIAN FEDERAL REGULATIONS:

CANADIAN DSL INVENTORY STATUS: Silane is listed on the Canadian DSL Inventory.

OTHER CANADIAN REGULATIONS: Deuterated Silane is categorized as a Controlled Product, Hazard Classes A, and B1 as per the Controlled Product Regulations. Deuterated Silane is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS:

Class A: Compressed Gas
Class B1: Flammable Gas



EUROPEAN ECONOMIC COMMUNITY REGULATIONS:

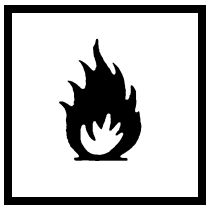
EC LABELING AND CLASSIFICATION: Silane meets the following definition of any hazard class, per the European Community Council Directive 67/548/EEC.

EC EINECS/ELINCS NUMBER: 215-605-7.
EC CLASSIFICATION: F+; (Extremely Flammable) Xi (Irritant)
EC RISK PHRASES: Extremely flammable. [R:12] Irritating to eyes, respiratory system and skin. [36,37,38]

EC SAFETY PHRASES: Keep container in well-ventilated place. Keep away from sources of ignition - No smoking. Take precautionary measures against static discharges. [S:9; S: 16; S: 33]

SECTION 15. REGULATORY INFORMATION (Continued)

EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOL: F+ (Extremely Flammable)



SECTION 16. OTHER INFORMATION

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.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES
Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

Further information about compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 4221 Wainey Road, 5th Floor, Chantilly, VA 20151-2923 Telephone: (703) 788-2700.

P-1	*"Safe Handling of Compressed Gases in Containers"*
AV-1	*"Safe Handling and Storage of Compressed Gases"*
G-5	*"Silane"*
	"Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
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4/1/04 Revision: corrected UN# within IMO information, Sec. 14
4/12/04 Revision: updated emergency phone
3/9/11 Revision: Linde rebranded; corrected CAS # in Sec. 2; added TSCA info Sec. 15