

Praxair Material Safety Data Sheet

(See section 15, under TSCA, for important restrictions on product use.)

1. Chemical Product and Company Identification

Product Name: Compressed gases, flammable, n.o.s. (disilane) (MSDS No. P-4825-D)	Trade Names: Disilane
Chemical Name: Disilane	Synonyms: Disilicane, silicoethane, silicon hexahydride
Chemical Family: Inorganic hydride	Product Grades: 4.8 Semiconductor Process Gas
Telephone: Emergencies: 1-800-645-4633* CHEMTREC: 1-800-424-9300* Routine: 1-800-PRAXAIR	Company Name: Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113

*Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).

2. Hazards Identification

EMERGENCY OVERVIEW

DANGER! Pyrophoric, flammable liquid and gas under pressure.
Can ignite on contact with air.
May form explosive mixtures with air.
Does not need a source of ignition.
Causes severe eye, skin, and respiratory tract irritation.
Self-contained breathing apparatus and protective clothing
may be required by rescue workers.
At normal temperature and pressure, this is a colorless gas
with a repulsive, choking odor.

OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

Effects of a Single (Acute) Overexposure

Inhalation. Severely irritates the nose, throat, and respiratory tract, characterized by coughing, choking, and pain in the center of the chest. May cause pulmonary edema (fluid in the lungs).

Skin Contact. Causes irritation and burns similar to thermal burns.

Swallowing. This product is a gas at normal temperature and pressure.

Eye Contact. Severely irritates the eyes causing painful burns. May cause delayed corneal injury.

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Effects of Repeated (Chronic) Overexposure. No information available.

Other Effects of Overexposure. None known.

Medical Conditions Aggravated by Overexposure. The toxicology and the physical and chemical properties of this product suggest that overexposure is unlikely to aggravate existing medical conditions.

CARCINOGENICITY: Disilane is not listed by NTP, OSHA, or IARC.

POTENTIAL ENVIRONMENTAL EFFECTS: None known. For further information, see section 12, Ecological Information.

3. Composition/Information on Ingredients

See section 16 for important information about mixtures.

COMPONENT	CAS NUMBER	CONCENTRATION
Disilane	1590-87-0	>99%*

*The symbol > means "greater than."

4. First Aid Measures

INHALATION: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

SKIN CONTACT: Flush area of exposure with large quantities of water while removing contaminated clothing and shoes. Call a physician.

SWALLOWING: An unlikely route of exposure; this product is a gas at normal temperature and pressure.

EYE CONTACT: Immediately flush eyes with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN: *There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.*

5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Gas may ignite spontaneously in air. At low ambient temperatures and high rates of flow, ignition may be delayed, and under sonic flow conditions, may not occur.

SUITABLE EXTINGUISHING MEDIA: Gas may ignite spontaneously in air. (Fire cannot be extinguished.)

PRODUCTS OF COMBUSTION: Silane, hydrogen, silicon dust

PROTECTION OF FIREFIGHTERS: DANGER! Pyrophoric, flammable liquid and gas under pressure. Evacuate all personnel from danger area. Do not use halon fire extinguisher. Do not approach area without self-contained breathing apparatus and protective clothing. Immediately spray cylinders with water from maximum distance until cool. Reverse flow into cylinder may cause rupture. (See section 16.) Stop flow of gas if without risk, while continuing cooling water spray. If flow of gas cannot be shut off, allow fire to burn out. Reduce combustion products with water spray or fog. Remove all cylinders from area if without risk. If fire is

extinguished while gas is present, explosive reignition may occur. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

Specific Physical and Chemical Hazards. Vapors may spread. Flammable vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. May form explosive mixtures with air. Heat of fire can build pressure in cylinder and cause it to rupture. No part of a cylinder should be subjected to a temperature higher than 125°F (52°C). Disilane cylinders are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.)

Protective Equipment and Precautions for Firefighters. Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! Pyrophoric, flammable liquid and gas under pressure.

Personal Precautions. Can ignite on contact with air. Forms explosive mixtures with air. (See section 5.) Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus and protective clothing where needed. Reduce combustion products with fog or fine water spray. Reverse flow into cylinder may cause rupture. (See section 16.) Shut off flow if without risk. Ventilate area or move cylinder to a well-ventilated area.

Environmental Precautions. Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: Spontaneously flammable—catches fire on contact with air. May form explosive mixtures with air. Does not need a source of ignition. **Use only spark-proof tools and explosion-proof equipment.** Keep away from heat, sparks, and open flame. **Protect cylinders from damage.** Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. **All piped disilane systems and associated equipment must be grounded.** Electrical equipment must be non-sparking or explosion-proof. **Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve.** Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. **Open valve slowly.** If valve is hard to open, discontinue use and contact your supplier. Close valve after each use; keep closed even when empty. For other precautions in using disilane, see section 16.

PRECAUTIONS TO BE TAKEN IN STORAGE: **Store cylinders outdoors in a protected but fully ventilated area.** Do not store with any other product. Separate disilane cylinders from oxygen, chlorine, and other oxidizers by at least 20 ft (6.1 m) or use a barricade of noncombustible material. This barricade should be at least 5 ft (1.53 m) high and have a fire resistance rating of at least ½ hour. **Store and use with adequate ventilation.** Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. **Post “No Smoking or Open Flames” signs in storage and use areas.** There must be no sources of ignition. All electrical equipment in storage areas must be

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explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas. **Store only where temperature will not exceed 125°F (52°C).** Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

RECOMMENDED PUBLICATIONS: For further information on storage, handling, and use, see Praxair publication P-14-153, *Guidelines for Handling Gas Cylinders and Containers*. Obtain from your local supplier.

8. Exposure Controls/Personal Protection

COMPONENT	OSHA PEL	ACGIH TLV-TWA (2007)
Disilane	Not established.	Not established.

IDLH = Not available.

ENGINEERING CONTROLS:

Local Exhaust. Inadequate to control worker's exposure.

Mechanical (General). Inadequate to control worker's exposure.

Special. Use only in a closed system.

Other. None

PERSONAL PROTECTIVE EQUIPMENT:

Skin Protection. Wear work gloves and metatarsal shoes when handling cylinders. Fire-resistant clothing, ear protection, vapor-proof goggles, and face shields are recommended when connecting or disconnecting transfer lines. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

Eye/Face Protection. Wear safety glasses when handling cylinders; vapor-proof goggles and a face shield during cylinder changeout or wherever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.

Respiratory Protection. Use an air-supplied respirator or a full-face, positive-pressure, self-contained breathing apparatus. Respirators must be acceptable to MSHA and NIOSH. Respiratory protection must conform to OSHA 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

9. Physical and Chemical Properties

APPEARANCE:	Colorless gas
ODOR:	Repulsive, choking
ODOR THRESHOLD:	Not available.
PHYSICAL STATE:	Gas at normal temperature and pressure
pH:	Not applicable.
MELTING POINT at 1 atm:	-206.5°F (-132.5°C)
BOILING POINT at 1 atm:	6.53°F (-14.15°C)
FLASH POINT (test method):	Pyrophoric gas (Not applicable.)
EVAPORATION RATE (Butyl Acetate = 1):	Not applicable.
FLAMMABILITY:	Flammable

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FLAMMABLE LIMITS IN AIR , % by volume:	LOWER: Pyrophoric	UPPER: Not available.
VAPOR PRESSURE at 70°F (21.1°C):	50 psia (344.74 kPa abs)	
VAPOR DENSITY at 70°F (21.1°C) and 1 atm:	0.1789 lb/ft ³ (2.577 kg/m ³)	
SPECIFIC GRAVITY (H ₂ O = 1):	Not available.	
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	2.148	
SOLUBILITY IN WATER 68°F (20°C):	Negligible	
PARTITION COEFFICIENT: n-octanol/water:	Not available.	
AUTOIGNITION TEMPERATURE:	Not available.	
DECOMPOSITION TEMPERATURE:	Not available.	
PERCENT VOLATILES BY VOLUME:	100	
MOLECULAR WEIGHT:	62.219	
MOLECULAR FORMULA:	Si ₂ H ₆	

10. Stability and Reactivity

CHEMICAL STABILITY: Unstable Stable

Disilane is stable as shipped and when stored, handled, and used under the conditions specified in this MSDS, sections 7, 10, and 16. Disilane must not be exposed to air or moisture.

CONDITIONS TO AVOID: Temperatures in excess of 572°F (300°C). Contact with incompatible materials.

INCOMPATIBLE MATERIALS: Air, water, solutions of bases, oxidizing agents, halogens, and halogenated compounds.

HAZARDOUS DECOMPOSITION PRODUCTS: Silane, hydrogen, silicon dust

POSSIBILITY OF HAZARDOUS REACTIONS: May Occur Will Not Occur

Fire or explosion may occur on contact with air, moisture, or other incompatible materials.

Decomposition may occur at high temperatures.

11. Toxicological Information

ACUTE DOSE EFFECTS: Not available.

STUDY RESULTS: None known.

12. Ecological Information

ECOTOXICITY: No known effects.

OTHER ADVERSE EFFECTS: Disilane does not contain any Class I or Class II ozone-depleting chemicals.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Compressed gases, flammable, n.o.s. (disilane)			
HAZARD CLASS: 2.1	PACKING GROUP/Zone: NA/NA*	IDENTIFICATION NUMBER: UN1954	PRODUCT RQ: None
SHIPPING LABEL(s): FLAMMABLE GAS			
PLACARD (when required): FLAMMABLE GAS			

*NA = Not applicable.

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(b)].

MARINE POLLUTANTS: Disilane is not listed as a marine pollutant by DOT.

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): None

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of Extremely Hazardous Substances (EHS) (40 CFR Part 355):

TPQ: None

EHS RQ (40 CFR 355): None

SECTIONS 311/312: Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: Yes

PRESSURE: Yes

DELAYED: No

REACTIVITY: Yes

FIRE: Yes

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

Disilane is not subject to reporting under Section 313.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Disilane is not listed as a regulated substance.

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TSCA: TOXIC SUBSTANCES CONTROL ACT: Disilane is not listed on the TSCA inventory.

CAUTION: This material is supplied under a “Low Volume Exemption” (40 CFR 723) of the Toxic Substances Control Act. As such, its use is restricted to the formation of silicon and silicon compounds to be used in the manufacture of semiconductor or photovoltaic devices.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Disilane is not listed in Appendix A as a highly hazardous chemical. However, any process that involves a flammable gas on site in one location in quantities of 10,000 lb (4536 kg) or greater is covered under this regulation unless the gas is used as a fuel.

STATE REGULATIONS:

CALIFORNIA: Disilane is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: Disilane is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: *Pyrophoric, flammable liquid and gas under pressure.* Spontaneously flammable—catches fire on contact with air. May form explosive mixtures with air. Does not need a source of ignition. **Use piping and equipment adequately designed to withstand pressures to be encountered.** Use only in a closed system thoroughly purged with an inert gas prior to introduction of disilane from cylinder. **Use only spark-proof tools and explosion-proof equipment.** Keep away from heat, sparks, and open flame. Close cylinder valve after each use; keep closed even when empty. **Prevent reverse flow.** Reverse flow into cylinder may cause rupture. Use a check valve or other protective device in any line or piping from the cylinder. **Store and use with adequate ventilation.** Isolate from all other products. **Follow safe practices when returning cylinder to supplier.** Be sure valve is closed; then install valve outlet cap or plug, leak tight. **Never work on a pressurized system.** If there is a leak, close the cylinder valve. Blow down the system in an environmentally safe manner in compliance with all federal, state, and local laws; then repair the leak. **Never place a compressed gas cylinder where it may become part of an electrical circuit.**

NOTE: Prior to using any plastics, confirm their compatibility with disilane. Use of plastic tubing with disilane is not recommended.

Mixtures. When you mix two or more gases or liquefied gases, you can 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 evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

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RECOMMENDED EQUIPMENT: In semiconductor process gas and other suitable applications, Praxair recommends the use of engineering controls such as gas cabinet enclosures, automatic gas panels (used to purge systems on cylinder changeout), excess-flow valves throughout the gas distribution system, double containment for the distribution system, and continuous gas monitors.

HAZARD RATING SYSTEMS:

NFPA RATINGS:

HEALTH = 1
FLAMMABILITY = 4
INSTABILITY = 2
SPECIAL = None

HMIS RATINGS:

HEALTH = 1
FLAMMABILITY = 4
PHYSICAL HAZARD = 2

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: CGA-350
PIN-INDEXED YOKE: Not applicable.
ULTRA-HIGH-INTEGRITY CONNECTION: CGA-632

Use the proper CGA connections. **DO NOT USE ADAPTERS.** Additional limited-standard connections may apply. See CGA pamphlet V-1 listed below. Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for this product. Further information can be found in the following materials published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, <http://www.cganet.com/Publication.asp>.

- AV-1 *Safe Handling and Storage of Compressed Gases*
- P-1 *Safe Handling of Compressed Gases in Containers*
- V-1 *Compressed Gas Cylinder Valve Inlet and Outlet Connections*
- *Handbook of Compressed Gases, Fourth Edition*

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

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