

Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Diborane (MSDS No. P-4586-F)	Trade Names: Diborane
Chemical Name: Diborane	Synonyms: Boroethane, boron hydride, diboron hexahydride
Chemical Family: Inorganic hydride	Product Grades: None assigned.
Telephone:	Company Name: Praxair, Inc.
Emergencies: 1-800-645-4633*	39 Old Ridgebury Road
CHEMTREC: 1-800-424-9300*	Danbury, CT 06810-5113
Routine: 1-800-PRAXAIR	

*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! Toxic, flammable high-pressure gas.

May be fatal if inhaled.

May cause respiratory system, kidney, and nervous system damage.



Symptoms may be delayed.

Can ignite on contact with air.



May form explosive mixtures with air.

Causes eye and skin irritation.

May cause asthmatic reaction.

Self-contained breathing apparatus must be worn by rescue workers.

Under ambient conditions, this colorless gas has a sweet, repulsive 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. May be fatal if inhaled. Diborane may irritate the respiratory tract, causing headache, coughing, nausea, tightening of the chest, shortness of breath, chills, fever, and weakness. May also damage the liver, kidneys, and central nervous system, producing drowsiness, dizziness, blurred vision, muscle twitching, and, possibly, painful muscle spasms. Lack of oxygen can kill.

Skin Contact. Diborane may irritate the skin, causing redness, possible swelling, and blisters.

Swallowing. An unlikely route of exposure. This product is a gas at normal temperature and pressure.

Eye Contact. Diborane may irritate the eyes, causing redness and swelling of the conjunctiva.

Effects of Repeated (Chronic) Overexposure. Repeated exposure may sensitize susceptible individuals, causing chronic respiratory distress.

Other Effects of Overexposure. None known.

Medical Conditions Aggravated by Overexposure. Because of its irritating properties, diborane may aggravate an existing dermatitis.

CARCINOGENICITY: Diborane is not listed by NTP, OSHA, and 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
Diborane	19287-45-7	>99%*

*The symbol > means "greater than."

4. First Aid Measures

INHALATION: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing, qualified personnel should give oxygen. Call a physician, even if no symptoms are present. Consider any exposure as a potentially toxic dose.

SKIN CONTACT: Remove contaminated clothing and wash skin using plenty of soap and water. Wash clothing before reuse. Call a physician.

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

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

NOTES TO PHYSICIAN: *Keep victims of overexposure under medical observation for 72 hours for delayed onset of pulmonary edema. There is no specific antidote. Treatment should be directed at the control of symptoms and the clinical condition of the patient.*

Contact the Poison Control Center in your area for additional information on patient management and follow-up.

5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Toxic, flammable gas.

SUITABLE EXTINGUISHING MEDIA: Diborane reacts violently with halogenated fire extinguishing agents, e.g., halon, carbon tetrachloride, etc. Protein-based foam or water is recommended.

PRODUCTS OF COMBUSTION: Combustion of diborane in air or oxygen produces boron oxide (B₂O₃).

PROTECTION OF FIREFIGHTERS: DANGER! Toxic, flammable high-pressure gas.

Evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Immediately cool cylinders with water spray from maximum distance, taking care not to extinguish flames. Remove ignition sources if without risk. If flames are accidentally extinguished, explosive reignition may occur. Reduce toxic vapors with water spray or fog. Stop flow of gas if without risk, while continuing cooling water spray. Reverse flow into cylinders may cause rupture. Remove all cylinders from area of fire if without risk. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

Specific Physical and Chemical Hazards. May form explosive mixtures with air and oxidizing agents. Heat of fire can build pressure in cylinder and cause it to rupture; no part of cylinder should be subjected to a temperature higher than 125°F (52°C). Cylinders containing diborane mixtures may be equipped with a pressure relief device. To provide maximum containment up to cylinder burst pressure, cylinders of pure diborane are not equipped with a pressure relief device. If leaking or spilled diborane catches fire, do not extinguish flames. Flammable and toxic vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check with an appropriate device. To protect persons from cylinder fragments and toxic fumes should a rupture occur, evacuate the area if the fire cannot be brought under immediate control.

Diborane may ignite spontaneously in air at or slightly above room temperature. The concentration required for ignition is, however, well above the permissible exposure level.

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! Toxic, flammable high-pressure gas.

Personal Precautions. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. May form explosive mixtures with air. Before entering area, especially a confined area, check atmosphere with an appropriate device. Remove all sources of ignition if without risk. Reduce vapors with fog or fine water spray. Reverse flow into cylinder may cause rupture. Shut off flow if without risk. Ventilate area or move cylinder to well-ventilated area. Prevent runoff from contaminating surrounding environment. Poisonous, flammable vapors may spread from spill.

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: May be fatal if inhaled. Do not breathe gas. Do not get vapors or liquid in eyes, on skin, or on clothing. **May form explosive mixtures with air.** Keep away from heat, sparks or open flame. Ground all equipment. Use only spark-proof

tools and explosion-proof equipment. Keep away from oxidizing agents and from other flammables. Have safety showers and eyewash fountains immediately available. Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. 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. For other precautions in using diborane, see section 16.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Separate diborane cylinders from oxygen 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. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. 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. 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 explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas.

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 (2008)
Diborane	0.1 ppm	0.1 ppm

TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

IDLH = 15 ppm

ENGINEERING CONTROLS:

Local Exhaust. Use explosion-proof local exhaust ventilation with sufficient air flow to keep the diborane concentration below the exposure limits in the worker's breathing zone.

Mechanical (General). Not recommended as a primary ventilation system to control worker's exposure.

Special. A canopy type of forced-air fume hood equipped with an explosion-proof device may be more desirable for certain applications.

Other. None

PERSONAL PROTECTIVE EQUIPMENT:

Skin Protection. Neoprene. (Rubber is attacked by diborane.) Metatarsal shoes for cylinder handling and protective clothing where needed. Select per 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. Select per OSHA 29 CFR 1910.133.

Respiratory Protection. A respiratory protection program that meet OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable) requirements must be followed whenever workplace conditions warrant respirator use. Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus.

9. Physical and Chemical Properties

APPEARANCE:	Colorless gas
ODOR:	Repulsive, sickly sweet
ODOR THRESHOLD:	Not available.
PHYSICAL STATE:	Gas at normal temperature and pressure
pH:	Not applicable.
MELTING POINT at 1 atm:	-265.9°F (-165.5°C)
BOILING POINT at 1 atm:	-134.5°F (-92.5°C)
FLASH POINT (test method):	-130°F (-90°C) TCC
EVAPORATION RATE (Butyl Acetate = 1):	Not available.
FLAMMABILITY:	Flammable
FLAMMABLE LIMITS IN AIR , % by volume:	LOWER: 0.9% UPPER: 98.0%
VAPOR PRESSURE at 59°F (15°C):	531.1 psia (3661 kPa, abs)
VAPOR DENSITY at 70°F (21.1°C) and 1 atm:	0.0715 lb/ft ³ (1.146 kg/m ³)
SPECIFIC GRAVITY (H ₂ O = 1) at 19.4°F (-7°C):	1.22
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	0.96
SOLUBILITY IN WATER 68°F (20°C):	Reacts
PARTITION COEFFICIENT: n-octanol/water:	Not available.
AUTOIGNITION TEMPERATURE:	125°F (51.7°C)
DECOMPOSITION TEMPERATURE:	Not available.
PERCENT VOLATILES BY VOLUME:	100
MOLECULAR WEIGHT:	27.67
MOLECULAR FORMULA:	B ₂ H ₆

10. Stability and Reactivity

CHEMICAL STABILITY: ☐ Unstable ☒ Stable

CONDITIONS TO AVOID: Heat, contact with air or water. Explodes on contact with chlorine or oxygen.

INCOMPATIBLE MATERIALS: Hydrocarbons, amines, aluminum, lithium, rubber, air, water, oxidizing agents, halogens, halogenated compounds, nitric acid, liquefied nitrogen trifluoride.

HAZARDOUS DECOMPOSITION PRODUCTS: Boron dust, hydrogen, higher boranes. Above 572°F (300°C), diborane begins to dissociate into hydrogen and boron. It is hydrolyzed by water to form hydrogen and boric acid.

POSSIBILITY OF HAZARDOUS REACTIONS: ☒ May Occur ☐ Will Not Occur

Diborane explodes on contact with chlorine or oxygen.

11. Toxicological Information

ACUTE DOSE EFFECTS: LC₅₀, 1 hr, rat = 80 ppm

STUDY RESULTS: None known.

12. Ecological Information

ECOTOXICITY: No known effects.

OTHER ADVERSE EFFECTS: Diborane 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: Diborane

HAZARD CLASS:	2.3	PACKING GROUP/Zone:	NA/A	IDENTIFICATION NUMBER:	UN1911	PRODUCT RQ:	None
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SHIPPING LABEL(s): POISON GAS, FLAMMABLE GAS **

PLACARD (when required): POISON GAS, FLAMMABLE GAS **

*NA=Not applicable.

**The words in the POISON GAS diamond are INHALATION HAZARD.

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.

Additional Marking Requirement: INHALATION HAZARD

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: Diborane 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: 100 lb

EHS RQ (40 CFR 355): 100 lb

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

DELAYED: Yes

PRESSURE: Yes

REACTIVITY: Yes

FIRE: Yes

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

Diborane 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.

Diborane is listed as a regulated substance in quantities of 2,500 pounds (1,134 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: Diborane is listed on the TSCA inventory.

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.

Diborane is listed in Appendix A as a highly hazardous chemical in quantities of 100 pounds (45.5 kg) or greater.

STATE REGULATIONS:

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

PENNSYLVANIA: Diborane 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: *Toxic, flammable high-pressure gas.* Use piping and equipment adequately designed to withstand pressures to be encountered. *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 at all times. Use only in a closed system. Close valve after each use; keep closed even when empty. *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. *Follow safe practices*

when returning cylinder to supplier. Be sure valve is closed; then install valve outlet plug tightly. **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 diborane.

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.

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 = 4
FLAMMABILITY = 4
INSTABILITY = 3
SPECIAL = ~~W~~

HMIS RATINGS:

HEALTH = 2
FLAMMABILITY = 4
PHYSICAL HAZARD = 3

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: CGA-350 connection is standard.
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*
- V-7 *Standard Method of Determining Cylinder Valve Outlet Connections for Industrial Gas Mixtures*
- *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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