Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Diborane, compressed (MSDS No. P-4586-E)	**Trade Name:** Diborane
Chemical Name: Diborane	**Synonyms:** Boroethane, boron hydride, diboron hexahydride
Formula: B_2H_6	**Chemical Family:** Inorganic hydride

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. Composition/Information on Ingredients

See section 16 for important information about mixtures.

INGREDIENT	CAS NUMBER	CONCENTRATION	OSHA PEL	ACGIH TLV-TWA (2004)
Diborane	19287-45-7	>99%*	0.1 ppm	0.1 ppm

** The symbol > means "greater than."*

3. 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.
Odor: Sickly sweet.

THRESHOLD LIMIT VALUE: TLV-TWA 0.1 ppm (ACGIH, 2004). TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

Revised

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.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: None known.

CARCINOGENICITY: Diborane is not listed by NTP, OSHA, and IARC.

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

FLASH POINT (test method):	-130°F (-90°C) TCC	
AUTOIGNITION TEMPERATURE:	125°F (51.7°C)	
FLAMMABLE LIMITS IN AIR, % by volume:	**LOWER:** 0.9%	**UPPER:** 98%

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

SPECIAL FIRE FIGHTING PROCEDURES: DANGER! Toxic, flammable high-pressure gas (see section 3). 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.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Toxic, flammable gas. 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 (TLV-TWA, section 2).

HAZARDOUS COMBUSTION PRODUCTS: Combustion of diborane in air or oxygen produces boron oxide (B_2O_3).

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: DANGER! Toxic, flammable high-pressure gas. 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 (see section 5). 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.

WASTE DISPOSAL METHOD: 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 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.

PRECAUTIONS TO BE TAKEN IN HANDLING: 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.

For further information on storage, handling, and use of this product, see NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*, published by the National Fire Protection Association.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST–Use explosion-proof local exhaust ventilation with sufficient air flow to keep the diborane concentration below the TLV 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

RESPIRATORY PROTECTION: Use an air-supplied respirator or a full-face, positive-pressure, self-contained breathing apparatus. Respiratory protection must conform to OSHA 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

SKIN PROTECTION: Neoprene. (Rubber is attacked by diborane.)

EYE PROTECTION: Wear safety glasses when handling cylinders. Select per OSHA 29 CFR 1910.133.

OTHER PROTECTIVE EQUIPMENT: 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.

9. Physical and Chemical Properties

MOLECULAR WEIGHT:	27.67
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm**:**	.955
SOLUBILITY IN WATER:	Reacts
PERCENT VOLATILES BY VOLUME:	100
BOILING POINT at 1 atm**:**	-134.5°F (-92.5°C)
MELTING POINT at 1 atm**:**	-265.9°F (-165.5°C)

APPEARANCE, ODOR, AND STATE: Colorless gas at normal temperature and pressure; repulsive, sickly sweet odor.

10. Stability and Reactivity

STABILITY: ☒ **Unstable** ☐ **Stable**

INCOMPATIBILITY (materials to avoid): 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.

HAZARDOUS POLYMERIZATION: ☒ **May Occur** ☐ **Will Not Occur**

CONDITIONS TO AVOID: Heat, contact with air or water. (See section 16.) Explodes on contact with chlorine or oxygen.

11. Toxicological Information

LC_{50} = 80 ppm, 1 hr, rat. See section 3.

12. Ecological Information

No information available on ecological effects. Diborane does not contain any Class I or Class II ozone-depleting chemicals. Diborane is not listed as a marine pollutant by DOT.

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, compressed

HAZARD CLASS: 2.3	**IDENTIFICATION NUMBER:** UN 1911	**PRODUCT RQ:** None

SHIPPING LABEL(s): POISON GAS, FLAMMABLE GAS*

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

**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: 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)].

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: 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	**PRESSURE:** Yes
DELAYED: 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 does not require 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: This product is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: This product 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.*** May be fatal if inhaled. Do not breathe gas. Do not get vapors or liquid in eyes, on skin, or on clothing. (See section 3.) Have safety showers and eyewash fountains immediately available. 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. ***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. 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.***

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.

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.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH	= 4	HEALTH	= 2
FLAMMABILITY	= 4	FLAMMABILITY	= 4
INSTABILITY	= 3	PHYSICAL HAZARD	= 3
SPECIAL	= ~~W~~		

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 pamphlets V-1 and V-7 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 about this product can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, Telephone (703) 412-0900, 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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