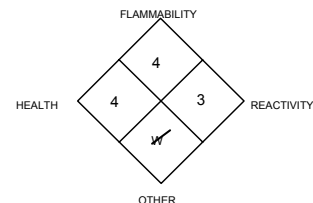


MATERIAL SAFETY DATA SHEET

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

NFPA RATING



PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **DIBORANE - B₂H₆**
Document Number: 001071

PRODUCT USE: For general analytical/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME: AIRGAS INC.
ADDRESS: 259 N. Radnor-Chester Road
 Suite 100
 Radnor, PA 19087-5283

BUSINESS PHONE: 1-610-687-5253
EMERGENCY PHONE: CHEMTREC: 1-800-424-9300
 International: 703-527-3887 (Call Collect)

DATE OF PREPARATION: May 17, 1998

2. COMPOSITION and INFORMATION ON INGREDIENTS

NOTE: Pure Diborane is rarely shipped to a customer. Pure Diborane is shipped in dry ice to a gas plant and down-filled to mixtures of less than 20% Diborane/inert gas.

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Diborane	19287-45-7	> 99%	0.1	NE	0.1	NE	15	NIOSH REL: 0.1 DFG MAK: 0.1
Maximum Impurities		< 1%	None of the trace impurities in this product contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Standard (29 CFR 1910.1200) and State equivalents standards.					

NE = Not Established

See Section 16 for Definitions of Terms Used.

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

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: PYROPHORIC GAS! Diborane is a colorless, water-reactive, extremely flammable gas, with sickly-sweet odor. Diborane is a powerful caustic irritant to skin, eyes and mucous membranes. Contact with the skin and eyes can cause burns and systemic poisoning. Persons who respond to releases of Diborane must protect themselves from inhalation of Diborane gas, especially in areas which are downwind of the release. Diborane burns in air or oxygen at room temperature, and can ignite in reaction to moisture in air, presenting a significant fire hazard to persons responding to a release. Diborane releases which have not spontaneously ignited must be considered extremely dangerous, and should not be approached. Emergency responders must have personal protective equipment and fire protection appropriate for the situation to which they are responding. Extreme caution must be used when responding to releases..

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: Diborane is toxic by all routes of exposure. The following paragraphs describe the symptoms of overexposure to this gas.

INHALATION: Inhalation exposure to low concentrations of Diborane can produce symptoms of central nervous system depression, including, light-headedness, headache, fatigue and drowsiness. Inhalation of Diborane vapors severely irritates the respiratory system. Inhalation of the gas causes a heat-producing reaction with moisture in the lungs, producing corrosive boric acid. Exposures to high concentrations of Diborane can include tightening of the chest, precordial pain, shortness of breath, non-productive cough, wheezing and nausea. Severe inhalation over-exposures can result in pulmonary edema and pulmonary hemorrhage. The onset of symptoms may be delayed by two days. Inhalation of high concentrations may be fatal.

Inhalation overexposures can also lead to systemic poisoning, with symptoms such as tremors, general lassitude, chills, vertigo, fever and muscle fasciculation (involuntary muscle movements or twitching).

CONTACT WITH SKIN or EYES: Direct exposure to the skin from the gas or liquid can cause severe burns. Minor contact with the liquid can result in local inflammation, blisters, redness and swelling. Contact with the eyes, even briefly, will cause irritation. Contact of longer duration and concentration can cause serious injury to the eyes, possibly blindness, due to the formation of boric acid.



SKIN ABSORPTION: No evidence exists that pure Diborane will be absorbed by intact skin; however upon decomposition as a result of contact with moisture in the skin, Diborane forms higher hydrides, which will penetrate the skin, causing systemic poisoning. Systemic poisoning symptoms can include those described in inhalation exposure.

INGESTION: While ingestion is highly unlikely, ingestion of Diborane can damage the tissues of the mouth, throat, esophagus, and other tissues of the digestive system. Ingestion of Diborane can be fatal. Additionally, aspiration by inhalation is possible, causing chemical pneumonia or death.

OTHER POTENTIAL HEALTH EFFECTS: Exposure to Diborane has caused injuries to the central nervous system, liver and kidneys in experimental animals. Similar observations have been reported in humans, resulting in symptoms resembling those of metal fume fever, such as, a metallic or sweet taste in the mouth, dryness or irritation of the throat, and coughing. Later symptoms (after 4-48 hours) can include sweating, shivering, headache, fever, chills, thirstiness, muscle aches, nausea, vomiting, weakness, and tiredness.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Overexposure to Diborane may cause the following health effects:

ACUTE: Acute exposure by inhalation can cause irritation to the eyes, skin, respiratory system and mucous membranes comparable to chlorine, fluorine, arsine or phosgene. Severe over-exposure by inhalation can cause damage to the respiratory system including the extremely dangerous condition of pulmonary edema (an accumulation of fluid in the lungs) and may be fatal. Acute exposure to the skin or eyes can cause irritation, or in cases of extreme contamination, burns and damage to tissue. Blindness to the eyes may result. Though unlikely to occur during occupational use, ingestion of large quantities may be fatal. Systemic poisoning can result after acute exposure by all routes of exposure.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH		(BLUE)	4
FLAMMABILITY		(RED)	4
REACTIVITY		(YELLOW)	3
PROTECTIVE EQUIPMENT			X
EYES	RESPIRATORY	HANDS	BODY
	SEE SECTION 8		SEE SECTION 8
For routine applications.			

See Section 16 for Definition of Ratings

3. HAZARD IDENTIFICATION (Continued)

CHRONIC: Persistent irritation may result from repeated exposures to this gas. Chronic exposure to relatively minor levels may cause permanent loss of lung efficiency, due to irreversible lung damage. Damage may also occur to the central nervous system, kidneys and liver.

TARGET ORGANS: Respiratory system, skin, eyes, liver, kidneys and central nervous system.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

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

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

INHALATION: Remove victim(s) to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Due to the delay in the onset of symptoms, all over-exposed individuals must receive medical evaluation.

SKIN EXPOSURE: If Diborane gas or liquid contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

EYE EXPOSURE: If liquid is splashed into eyes, or if irritation of the eye develops after exposure to liquid or gas, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Administer anesthetic eye drops after one minute of flushing if victim suffers from spasms to the eyes, in order to facilitate irrigation.

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

5. FIRE-FIGHTING MEASURES

FLASH POINT: -90°C (-130°F)

AUTOIGNITION TEMPERATURE: 40 to 50°C (104-122°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 0.8%

Upper (UEL): 98.0%

FIRE EXTINGUISHING MATERIALS: Use extinguishing agent appropriate for surrounding materials in a fire. Use water spray to keep fire-exposed containers cool. **Do not use halogenated fire-extinguishing agents.** Diborane reacts with these materials and will form shock sensitive and thermally sensitive mixtures.

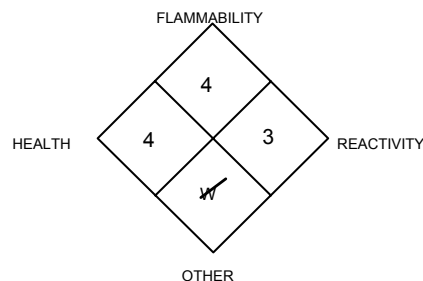
UNUSUAL FIRE AND EXPLOSION HAZARDS: Diborane is very toxic via inhalation, eye and skin contact; this gas presents an extreme health hazard to firefighters. Diborane presents extreme hazards as it is readily capable of explosive decomposition or exothermic reaction in air, oxygen, or moisture and a variety of organic and inorganic materials. In the event of fire, cool containers of this product with water to prevent failure. Do not direct water directly onto the Diborane release, as Diborane will react with water and may intensify the fire. **Diborane 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 cylinders or storage vessels can be very dangerous. Direct flame exposure on the cylinder wall can cause an explosion by exothermic decomposition. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the vessel. 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: Pure Diborane is insensitive to mechanical impact; however, Diborane can become shock and thermally sensitive in the presence of impurities such as oxygen, water, halogenated hydrocarbons and other materials..

Explosion Sensitivity to Static Discharge: Diborane is extremely sensitive to static discharge and can readily ignite.

NFPA RATING



See Section 16 for Definition of Ratings

5. FIRE-FIGHTING MEASURES (Continued)

SPECIAL FIRE-FIGHTING PROCEDURES: Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. The best fire-fighting technique may be simply to let the burning gas escape from the leak. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the still leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. In this case, increase ventilation to prevent flammable or explosive mixture formation.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area and protect people. Adequate fire protection must be provided.

Minimum Personal Protective Equipment should be **Level A: triple-gloves (rubber gloves and nitrile gloves, over latex gloves), fully-encapsulating chemically resistant suit, fire-retardant protective clothing, and boots, hard-hat, and Self Contained Breathing Apparatus.** Small releases of Diborane leaks can be detected by means of an atomizer or squeeze bottle filled with aqueous ammonia. A white cloud will show the location of the leak. Monitor the surrounding area for Diborane and oxygen levels.

The atmosphere must have less than 50% of the PEL (PEL = 0.1 ppm) of Diborane and greater than 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. To determine the level of Diborane, use a direct reading instrument (e.g., MDA Scientific TLD-1 Toxic Gas Detector). Attempt to close the main source valve prior to entering the area. If this does not stop the release (or it is not possible to reach the valve), allow the gas to release in place or remove it to a safe area and allow the gas to be released there. If necessary neutralize areas and items contaminated with Diborane with a solution of 5% ammonia and 5% trisodium phosphate. Decontaminate all equipment used in the response thoroughly.

THIS IS AN EXTREMELY FLAMMABLE, TOXIC GAS. Protection of all personnel and the area must be maintained. All responders must be adequately protected from exposure.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: All areas where Diborane is used should be monitored with very sensitive gas detection instruments. Detection of concentrations below 50% of the PEL (PEL = 0.1 ppm) should trigger immediate response and corrective action. Detection of higher levels should initiate an alarm calling for evacuation of all personnel with the potential to be exposed. Due to the extreme corrosivity and toxicity of Diborane and pyrophoric qualities of Diborane, all contaminated clothing should be removed and placed in a sealed container for proper disposal. Be aware of any signs of overexposure [See Section 3 (Hazard Identification)], because overexposure to fatal concentrations of this product could occur without any significant warning symptoms. Avoid all contact with this gas. All employees who handle this material should be trained to handle it safely. It is highly suggested that persons work with Diborane in pairs within sight and sound of each other, but in different areas. Avoid breathing the gas or sprays or mists generated by Diborane. Cylinders of Diborane should be stored away from organic or combustible materials. Personnel using Diborane should be protected by a cylinder enclosure or barricade and remote control valves, operated from outside the barrier or enclosure. Wash hands after handling chemicals. Do not eat or drink while handling chemicals. All work practices should minimize the release of Diborane.

- Workers who handle Diborane should wear protective clothing, as listed in Section 8 (Exposure Controls and Personal Protection).
- Instant-acting showers should be available in the event of an emergency.
- Special eye-wash fountains or similar equipment should be available for eye irrigation.
- Proper respiratory protection equipment must be provided and workers using such equipment must be carefully trained in its operation and limitations.
- Precautions must always be taken to prevent suck-back of foreign materials into the cylinder by using a check-valve, or vacuum break, since suckback may cause dangerous pressure changes within the cylinder.
- All areas in which Diborane is used must have adequate monitoring equipment to detect a release and appropriate fire protection equipment.

STORAGE AND HANDLING PRACTICES: Diborane must be stored in conditions that prevent decomposition and contact with air or moisture. Thermal decomposition of Diborane as a result of contamination by oxygen, moisture or other incompatible materials can cause excessive build-up of pressure, leading to failure of the cylinder. Cylinders must be designed to contain such resultant decomposition pressure should it occur. Use only compatible materials for cylinders, process lines, and other Diborane-handling equipment. Lines should be purged with dry nitrogen both before and after maintenance activity.

7. HANDLING and STORAGE (Continued)

STORAGE AND HANDLING PRACTICES (continued): Use a check valve or other protective device in the discharge line to prevent hazardous backflow. Never tamper with pressure relief valves and cylinders. Periodic inspections of process equipment by knowledgeable persons should be made to ensure that the equipment is used appropriately and the system is kept in suitable operating condition. Diborane emergency equipment should be available near the point of use.

Keep the smallest amount necessary on-site at any one time. Full and empty cylinders should be segregated. Use a first-in, first-out inventory systems to prevent full containers from being stored for long periods of time. Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Compressed gases can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Post "No Smoking or Open Flames" signs in storage or use areas.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated, fireproof area, away from flammable materials and corrosive atmospheres. Store away from heat and ignition sources and out of direct sunlight. Do not store near elevators, corridors or loading docks. Do not allow area where cylinders are stored to exceed 52°C (125°F). Avoid storing products by incompatible chemicals. Do not store containers where they can come into contact with moisture. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. The following rules are applicable to situations in which cylinders are being used:

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

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

After Use: Close main cylinder valve. Replace valve protection cap. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME Code containers. Earth-ground and bond all lines and equipment associated with this product. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. Additionally, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. A hood with forced ventilation is preferable. Because of the high hazard associated with Diborane, stringent control measures such as a gas cabinet enclosure or isolation may be necessary. Ductwork should be constructed of non-metallic material, or should be lined to resist corrosion. If appropriate, install automatic monitoring equipment to detect the level of Diborane.

RESPIRATORY PROTECTION: Maintain exposure levels of Diborane below the levels listed in Section 2 (Composition and Information on Ingredients) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Diborane levels exceed exposure limits and if oxygen level is below 19.5% or during emergency response to a release of this product. If respiratory protection is needed, use only protection authorized in the U.S. Federal OSHA Standard (29 CFR 1910.134), applicable U.S. State regulations, or the appropriate standards of Canada and its Provinces. Use supplied air respiration protection if oxygen levels are below 19.5% or are unknown. The following NIOSH respiratory protection recommendations are for Diborane.

CONCENTRATION

RESPIRATORY EQUIPMENT

Up to 1 ppm

Supplied Air Respirator (SAR)

Up to 2.5 ppm

Supplied Air Respirator (SAR) operated in continuous-flow mode.

Up to 5 ppm

Supplied Air Respirator (SAR) with tight-fitting facepiece operated in continuous-flow mode, or full-facepiece SCBA, or full-facepiece Supplied Air Respirator (SAR).

Up to 15 ppm

Positive-pressure, full-facepiece Supplied Air Respirator.

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive-pressure, full facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Escape

Gas mask with canister to protect against Diborane or escape-type SCBA should be used.

The IDLH concentration for Diborane is 15 ppm.

EYE PROTECTION: Splash goggles or safety glasses and face shield.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

HAND PROTECTION: Wear mechanically-resistant gloves when handling cylinders of this product. Wear chemically resistant gloves appropriate for use with Diborane for industrial use. Gloves made of butyl rubber are not recommended. Use triple gloves for spill response (see Section 6, Accidental Release Measures).

BODY PROTECTION: Use body protection appropriate for task. An apron, or other impermeable body protection is suggested. Full-body chemical protective clothing is recommended for emergency response procedures.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for pure Diborane.

VAPOR DENSITY @ 21.1°C (70°F): 0.0712 lb/ft³ (1.14 kg/m³) **EVAPORATION RATE (nBuAc = 1):** Not applicable.

SPECIFIC GRAVITY (air = 1): 0.952

FREEZING POINT: -165.5°C (-265.9°F)

VAPOR PRESSURE @ 15.5°C (60°F): 536.55 psia

ODOR THRESHOLD: 1.8-3.5 ppm

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

EXPANSION RATIO: Not applicable.

SPECIFIC VOLUME (ft³/lb): 12.84

BOILING POINT @ 1 atm: -92.5°C (-134.5°F)

GAS DENSITY @ 0°F (32°C): 0.0779 lb/ft³ (1.25 kg/m³)

LIQUID DENSITY @ 0°F (32°C): 16.9 lb/ft³ (271 kg/m³)

SOLUBILITY IN WATER: Decomposes to form boric acid and hydrogen.

pH: Not applicable to the gas.

APPEARANCE AND COLOR: Diborane is a colorless gas, with a sickly sweet odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor is not a good warning property for Diborane as it rapidly deadens the sense of smell so that concentrations above the odor threshold can no longer be detected. Monitoring systems must be used for detection of this gas.

10. STABILITY and REACTIVITY

STABILITY: Diborane mixes readily with air to form explosive mixtures and may ignite spontaneously.

DECOMPOSITION PRODUCTS: When heated to decomposition, Diborane forms hydrogen gas and boric acid.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Diborane will react explosively with moisture in the air. Diborane will react explosively with tetravinyl lead, octanol oximine and sodium hydroxide mixtures, benzene. Diborane will react violently with halocarbon liquids, strong oxidizers (e.g. chlorine gas) or boron hydrides. Diborane reacts with aluminum and lithium to form complex hydrides that can ignite spontaneously in air. In the presence of oxygen and halogenated hydrocarbons Diborane will form shock sensitive and thermally sensitive mixtures. Diborane will attack some forms of rubber and plastics.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid exposing cylinders to extremely high temperatures, which could cause the cylinders to rupture. Avoid contact with incompatible materials and exposure to the air and/or moisture.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following data is for Diborane.

Inhalation-Rat LC₅₀: 40 ppm/4 hours

Inhalation-Mouse LC₅₀: 29 ppm/4 hours

Inhalation-Dog, adult LCLo: 125 ppm/2 hours

Inhalation-Hamster LCLo: 50 ppm/8 hours

Mutation in microorganisms: Bacteria - Salmonella: 2000 ppm

Mutation in microorganisms - Salmonella typhimurium: 5000 ppm

TCLo - Inhalation - rat: 100 ppb/6 hours/8 weeks - Intermittent; Lungs, Thorax, or Respiration - other changes Blood - pigmented or nucleated red blood cells Nutritional and Gross Metabolic - changes in sodium

TCLo - Inhalation - mouse: 5 ppm/6 hours/4 weeks - Intermittent; Lungs, Thorax, or Respiration - changes in lung weight Blood - changes in erythrocyte (RBC) count Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - phosphatases

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

IRRITANCY OF PRODUCT: Diborane is severely irritating to contaminated tissue.

SENSITIZATION OF PRODUCT: Diborane is not known to be a sensitizer to humans upon prolonged or repeated contact.

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

11. TOXICOLOGICAL INFORMATION (Continued)

Mutagenicity: No human mutagenic effects have been described for Diborane.

Embryotoxicity: No human embryotoxic effects have been described for Diborane.

Teratogenicity: No human teratogenic effects have been described for Diborane.

Reproductive Toxicity: No human reproductive effects have been described for Diborane.

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

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE Pre-existing dermatitis, other skin conditions, and respiratory disorders may be aggravated by over-exposure to Diborane. Additionally, over-exposures may aggravate problems with the eyes, liver, kidneys and central nervous system, as well as disorders involving the "Target Organs", as listed in Section 3 (Hazard Information), may be aggravated by overexposure to Diborane.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary. Treatment is symptomatic and supportive. Be observant for initial signs of pulmonary edema..

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

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: In water, Diborane will decompose on contact to form boric acid. All work practices should be aimed at eliminating environmental contamination

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Diborane may be harmful or fatal to contaminated plant and animal-life (especially if large quantities of this product are released). Refer to section 11 (Toxicological Information) for additional information on effects on animals

EFFECT OF CHEMICAL ON AQUATIC LIFE: Diborane will form boric acid in water, and can be detrimental to aquatic life. If a release this product occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life. The following aquatic toxicity data for boric acid is presented, to provide additional information:

LC₅₀ (trout eggs) = 100 ppm/ soft
LC₅₀ (trout eggs) = 79 ppm/ hard
LC₅₀ (catfish eggs) = 155 ppm/ soft
LC₅₀ (catfish eggs) = 22 ppm/ hard

LC₅₀ (goldfish eggs) = 46 ppm/ soft
LC₅₀ (goldfish eggs) = 75 ppm/ hard
LC₅₀ (*Daphnia magna*) = 133 mg/L/ 48 hours

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate U.S. Federal, State, and local regulations or with regulations of Canada and its Provinces. Return cylinders with residual product to Airgas, Inc. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

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

PROPER SHIPPING NAME: Diborane
HAZARD CLASS NUMBER and DESCRIPTION: 2.3 (Toxic Gas or Poison Gas)
UN IDENTIFICATION NUMBER: UN 1911
PACKING GROUP: Not applicable.
DOT LABEL(S) REQUIRED: Poison Gas, Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 119

SPECIAL PROVISION: This material must be described "Poison-Inhalation Hazard Zone A" on shipping papers and containers must be marked per the requirements of 49 CFR 172.313.

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

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

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

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

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Diborane	YES	YES	NO

U.S. SARA THRESHOLD PLANNING QUANTITY: 100 pounds.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Diborane has a 100 pound Reportable Quantity as an Extremely Hazardous Substance.

U.S. TSCA INVENTORY STATUS: Diborane listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Diborane is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 2,500 pounds. Depending on specific operations involving the use of Diborane, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Diborane is listed in Appendix A of this regulation. The threshold quantity for Diborane under this regulation is 100 lbs. Diborane does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82). Diborane is listed under Table 1 as a Regulated Substance, Toxic Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Release Prevention. Diborane is listed as an Extremely Hazardous Substance. The threshold quantity for Diborane under this regulation is 100 lbs.

U.S. STATE REGULATORY INFORMATION: Diborane is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Diborane.

California - Permissible Exposure Limits for Chemical Contaminants: Diborane.

Florida - Substance List: Diborane.

Illinois - Toxic Substance List: Diborane.

Kansas - Section 302/313 List: Diborane.

Massachusetts - Substance List: Diborane.

Michigan - Critical Materials Register: Diborane.

Minnesota - List of Hazardous Substances: Diborane.

Missouri - Employer Information/Toxic Substance List: Diborane.

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

North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.

Pennsylvania - Hazardous Substance List: Diborane.

Rhode Island - Hazardous Substance List: Diborane.

Texas - Hazardous Substance List: Diborane.

West Virginia - Hazardous Substance List: Diborane.

Wisconsin - Toxic and Hazardous Substances: Diborane.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Diborane is not on the California Proposition 65 lists.

CGA LABELING (For Compressed Gas):

DANGER:

PYROPHORIC, FLAMMABLE, CORROSIVE HIGH PRESSURE GAS.
CAN IGNITE ON CONTACT WITH AIR.
MAY FORM EXPLOSIVE MIXTURES WITH AIR.
MAY CAUSE EYE, SKIN, AND RESPIRATORY TRACT BURNS.

Avoid breathing gas.

Keep away from heat, flames, and sparks.

Use only with equipment purged with inert gas, evacuated prior to discharge from cylinder.

Use equipment rated for cylinder pressure.

Store and use with adequate ventilation.

Close valve after each use and when empty.

Cylinder temperature should not exceed 52°C (125°F).

WHEN RETURNING CYLINDER, INSTALL VALVE OUTLET CAP OR PLUG, LEAK-TIGHT.

Use in accordance with the Material Safety Data Sheet.

FIRST AID:

IF INHALED, remove to fresh air. If not breathing, give artificial respiration. (Rescuer may receive chemical burns as a result of giving mouth to mouth). If breathing is difficult, give oxygen. Call a physician. Keep under medical observation.

IN CASE OF CONTACT, immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. (Discard contaminated shoes).

DO NOT REMOVE THIS PRODUCT LABEL.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL INVENTORY: Diborane is listed on the DSL Inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: Diborane is not on the CEPA Priorities Substances Lists.

OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN WHMIS SYMBOLS:

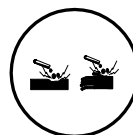
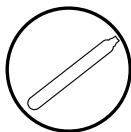
Class A: Compressed Gas

Class B1: Flammable Gas

Class D1A: Material Causing Serious and Immediate Effects

Class E: Corrosive

Class F: Dangerously Reactive Material



16. OTHER INFORMATION

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
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The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (*Federal Register*: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order. **IDLH** - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]). Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. **Ecological Information:** **EC** is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. **Tm** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **U.S.:** **EPA** is the U.S. Environmental Protection Agency. **DOT** is the U.S. Department of Transportation. **SARA** is the Superfund Amendments and Reauthorization Act. **TSCA** is the U.S. Toxic Substance Control Act. **CERCLA (or Superfund)** refers to the Comprehensive Environmental Response, Compensation, and Liability Act. Labeling is per the American National Standards Institute (**ANSI Z129.1**). **CANADA:** **CEPA** is the Canadian Environmental Protection Act. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **TC** is Transport Canada. **DSL/NDL** are the Canadian Domestic/Non-Domestic Substances Lists.