1. PRODUCT IDENTIFICATION

PRODUCT NAME: Diborane Mixtures
CHEMICAL NAME: Boron Hydride
FORMULA: B2H6 in Ar, He, H2, or N2
SYNONYMS: Diborane, Boron Hydride, Boroethane

MANUFACTURER:
Air Products and Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, PA 18195-1501

PRODUCT INFORMATION: (800) 752-1597

MSDS NUMBER: 1028
REVISION: 6
REVIEW DATE: January 2000
REVISION DATE: January 2000

2. COMPOSITION / INFORMATION ON INGREDIENTS

Greater than 0 to 10% Diborane in a base gas of argon, helium, hydrogen, or nitrogen.

CAS NUMBER: 19287-45-7 (pure diborane)

EXPOSURE LIMITS: (pure diborane)
OSHA: PEL = 0.1 ppm
ACGIH: TWA/TLV = 0.1 ppm
NIOSH: IDLH = 15 ppm

3. HAZARD IDENTIFICATION

DIBORANE MIXTURES; B2H6 IN AR, HE, H2, OR N2 (FILE #040111)
EMERGENCY OVERVIEW:
Diborane is a colorless, highly toxic, extremely flammable gas sold in mixtures with hydrogen, helium, nitrogen and argon at pressures up to 2100 psig. Its odor is described as sickly sweet. May be fatal if inhaled or absorbed through skin. Pure diborane is pyrophoric. Mixtures of diborane greater than 0.8% should also be treated as pyrophoric. Wear self-contained breathing apparatus (SCBA) as well as fire resistant total body covering when entering areas of suspected diborane exposure. Personnel entering areas containing flammable gases must be aware of the extreme fire and explosion hazard.

EMERGENCY TELEPHONE NUMBERS
(800) 523-9374 Continental U.S., Canada, and Puerto Rico
(610) 481-7711 other locations

ACUTE POTENTIAL HEALTH EFFECTS:

ROUTES OF EXPOSURE:

EYE CONTACT:
May cause irritation, redness and swelling of the conjunctiva.

INGESTION: Not applicable

INHALATION:
Diborane is an irritant to the respiratory tract and a central nervous system depressant. Symptoms may include headache, nausea, fatigue, shivering, drowsiness, shortness of breath, coughing, chest tightness, pulmonary edema, convulsions and death. Symptoms may be delayed.

SKIN CONTACT:
May cause irritation, redness, swelling and blisters.

POTENTIAL HEALTH EFFECTS OF REPEATED EXPOSURE:

ROUTE OF ENTRY: Inhalation

TARGET ORGANS: Respiratory and central nervous systems.

SYMPTOMS:
Repeated exposure to very low concentrations may result in nausea, dizziness, vertigo, chills, headache, fatigue, muscular weakness, drowsiness, chest tightness, dyspnea, coughing and wheezing. Respiratory system chronic disability is on a hypersensitivity basis. Pneumonitis or asthmatic bronchitis may occur in sensitive individuals. For sublethal exposures, symptoms may be present for several days before resolving.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:
May aggravate asthma and inflammatory or fibrotic pulmonary disease.

CARCINOGENICITY:
Diborane is not listed as a carcinogen or potential carcinogen by NTP, IARC, or OSHA.

4. FIRST AID MEASURES

Prompt medical attention is required in all cases of overexposure.
to diborane and its by-products. Rescue personnel should be equipped with appropriate protective equipment (self-contained breathing apparatus (SCBA), etc.) to prevent unnecessary exposure and must be aware of the fire and explosion potential of diborane.

EYE CONTACT:
Flush contaminated eye(s) with copious amounts of fresh water. Hold eyelids open to assure complete flushing. Continue for minimum of fifteen minutes. Seek medical attention immediately.

INGESTION:
Diborane is a gas at room temperature and pressure making ingestion unlikely.

INHALATION:
Move exposed personnel to uncontaminated area. If not breathing, give artificial respiration. Mouth to mouth resuscitation is not recommended. If breathing is difficult, give oxygen. Seek prompt medical attention and continue with administration of oxygen. If airway obstruction occurs, the placement of an artificial airway by an emergency medical technician, may be necessary.

SKIN CONTACT:
Remove contaminated clothing and wash skin with soap and water.

NOTES TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: Not applicable
AUTOIGNITION: 100 (F) (38 (C)
FLAMMABLE RANGE: 0.8% - 98%

EXTINGUISHING MEDIA:
Only acceptable agents are protein based foams with a nitrogen carrier.

SPECIAL FIRE FIGHTING INSTRUCTIONS:
Evacuate all personnel from area. If possible without shut off source of gas. Diborane reacts with most extinguishing media such as water, carbon dioxide, chemical powders and halogenated compounds. Extinguish fire only if gas flow can be stopped. This will avoid possible accumulation and re-ignition of a flammable gas mixture. Keep adjacent cylinders cool by spraying with large amounts of water until the fire burns itself out. Self-contained breathing apparatus (SCBA) may be required.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Mixtures of diborane greater than 0.8% may ignite spontaneously in moist air. Upon exposure to intense heat or flame, cylinder will vent rapidly and/or rupture violently.

HAZARDOUS COMBUSTION PRODUCTS: Oxides of boron

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Evacuate immediate area. Eliminate any possible sources
of ignition, provide maximum explosion-proof ventilation and monitor diborane levels. Use appropriate protective equipment. Shut off source of leak if possible. Isolate any leaking cylinder. If leaking from container or its valve, contact your supplier. If leak is in user's system, close cylinder valve, safely vent pressure and purge with inert gas before attempting repairs.

7. HANDLING AND STORAGE

STORAGE:
Store cylinders in a well-ventilated, secure area, protected from the weather. Cylinders should be stored upright with valve outlet seals and valve protection caps in place. There should be no sources of ignition. All electrical equipment should be explosion-proof in storage areas. Storage areas must meet National Electrical Codes for class 1 hazardous areas. Flammable storage areas should be separated from oxygen and other oxidizers by a minimum distance of 20 ft. or by a barrier of non-combustible material at least 5 ft. high having a fire resistance rating of at least 1/2 hour. Post "No Smoking or Open Flames" signs in the storage or use areas. Do not allow storage temperature to exceed 125°F (52°C). Storage should be away from heavily traveled areas and emergency exits. Full and empty cylinders should be segregated. Use a first-in first-out inventory system to prevent full containers from being stored for long periods of time.

HANDLING:
Do not drag, roll, slide or drop cylinder. Use a suitable handtruck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure reducing regulator or separate control valve to safely discharge gas from cylinder. Use a check valve to prevent reverse flow into the cylinder. Use piping and equipment adequately designed to withstand pressures to be encountered. Never apply flame or localized heat directly to any part of the cylinder. Once cylinder has been connected to process, open cylinder valve slowly and carefully. If user experiences any difficulty operating the cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings. Doing so may damage valve causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

SPECIAL PRECAUTIONS:
Diborane appears to be non-corrosive to most metals except aluminum. Teflon(r), Kel-F(r) are the preferred gasketing materials. Diborane is also compatible with glass, Pyrex(r) and quartz. Earth ground and bond all lines and equipment associated with the diborane system. Electrical equipment should be non-sparking explosion proof. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, Safe Handling of Compressed Gases in Containers. Local regulations may require specific equipment for storage or use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION
ENGINEERING CONTROLS:
VENTILATION: Hood with forced ventilation.

RESPIRATORY PROTECTION:
Emergency Use:
Positive pressure air line with mask or self-contained breathing apparatus (SCBA) should be available for emergencies.

EYE PROTECTION: Chemical goggles or safety glasses as a minimum.
SKIN PROTECTION: Plastic or rubber gloves
OTHER PROTECTIVE EQUIPMENT:
Safety shoes, safety shower, eyewash fountain.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical and chemical properties listed are for pure diborane.

APPEARANCE, ODOR AND STATE:
Colorless gas with an unpleasant, sickly sweet odor.

MOLECULAR WEIGHT: 27.67

BOILING POINT (At 1 atm): -135.1 (F (-92.8 (C)

SPECIFIC GRAVITY (also called vapor density)(Air =1): 0.95

FREEZING POINT / MELTING POINT: -264.8 (F (-164.9 (C)

VAPOR PRESSURE (At 70 (F (21.1 (C):
Above the critical temperature of 62.1 (F (16.7 (C)

GAS DENSITY (At 70 (F (21.1 (C) and 1 atm): 0.0721 lb/ft3

SOLUBILITY IN WATER (Vol./Vol. at 32 (F (0 (C) and 1 atm): Hydrolyzes to form boric acid and hydrogen.

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Unstable

CONDITIONS TO AVOID:
At room temperature diborane decomposes to produce hydrogen and higher boranes. Decomposition rate increases with increasing temperature and concentration producing non-volatile boranes such as tetraborane and pentaborane. Higher borane decomposition products may be more shock sensitive than pure diborane. Diborane dissociates to boron and hydrogen at temperatures exceeding 570 (F (300 (C). Because of the instability of pure diborane, Air Products only offers diborane in mixtures with other gases which act as diluents and retard its decomposition.

INCOMPATIBILITY (Materials to Avoid):
Oxidizing agents, aluminum, lithium, halogenated compounds and metal oxides.

REACTIVITY:
A) HAZARDOUS DECOMPOSITION PRODUCTS:
A condensation reaction will produce hydrogen and higher boranes.
11. TOXICOLOGICAL INFORMATION

Toxicology information listed is for pure diborane.

LC50 (Inhalation):
- 40 ppm (rat, 4 hour); 80 ppm (rat, 1 hour time adjusted)

LD50 (Oral): Not available

LD50 (Dermal): Not available

Carcinogenicity: No data

Skin Corrosivity: Irritant

Additional Notes:
The toxicity of diborane is similar to phosgene. Pulmonary edema is very likely. The symptoms may be delayed as much as 24 hours.

12. ECOLOGICAL INFORMATION

AQUATIC TOXICITY:
This product is not listed as a marine pollutant by DOT (49CFR). There is no definitive aquatic toxicity data available.

Mobility: Unknown

Persistence and Biodegradability: Unknown

Potential to Bioaccumulate: Unknown

Remarks:
Do not release large amounts of diborane to the atmosphere. This product does not contain any Class I or Class II ozone depleting chemicals.

13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER:
Return cylinder and unused product to supplier. Do not attempt to dispose of unused product.

Disposal Information:
Destruction via incineration followed by scrubbing is the most commonly used method.

14. TRANSPORT INFORMATION

Contact Air Products and Chemicals, Inc. for DOT shipping information.

Special Shipping Information:
Cylinders should be transported in a secure upright position in a well-ventilated truck. Never transport in passenger compartment of a vehicle. Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

Caution:
Compressed gas cylinders shall not be refilled except by
qualified producers of compressed gases. The filling and shipping of a compressed gas cylinder without the written consent of the cylinder's owner is in violation of federal law (49 CFR 173.301).

15. REGULATORY INFORMATION

Regulatory information listed is for pure diborane.

U.S. FEDERAL REGULATIONS:
EPA - ENVIRONMENTAL PROTECTION AGENCY

CERCLA:
Reportable Quantity (RQ): None

SARA TITLE III:
Superfund Amendment and Reauthorization Act
SECTIONS 302/304:
Emergency Planning and Notification (40 CFR Part 355)
Extremely Hazardous Substances: Diborane is listed.
Threshold Planning Quantity (TPQ): 100 lbs
Reportable Quantity (RQ): 100 lbs

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)
IMMEDIATE HEALTH: Yes
PRESSURE: Yes
DELAYED HEALTH: Yes
REACTIVITY: Yes
FIRE: Yes

SECTION 313: Toxic Chemical Release Reporting (40 CFR Part 372)
Diborane does require reporting under Section 313.

CLEAN AIR ACT:
SECTION 112 (r): Risk Management Programs for Chemical Accidental Release (40 CFR PART 68)
Diborane is listed as a regulated substance.
Threshold Quantity (TQ): 2500 lbs

TSCA: Toxic Substance Control Act
Diborane is listed on the TSCA inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119:
Process Safety Management of Highly Hazardous Chemicals
Diborane is listed as a highly hazardous chemical.
Threshold Quantity (TQ): 100 lbs

STATE REGULATIONS:

CALIFORNIA:
Proposition 65:
Diborane is not a listed substance which the State of California requires warning under this statute.

16. OTHER INFORMATION

NFPA RATINGS: HEALTH: 4
HMIS RATINGS: HEALTH: 4
FLAMMABILITY: = 4   FLAMMABILITY: = 4
INSTABILITY: = 3   REACTIVITY: = 3
SPECIAL: W