1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: >= 0.8 - 1.6% DIBORANE In NITROGEN
Product Code(s): G-26
UN-Number: UN1954
Recommended Use: Electronics.

Supplier Address*: Linde Gas North America LLC - Linde Merchant Production Inc. - Linde LLC
575 Mountain Ave.
Murray Hill, NJ 07974
Phone: 908-464-8100
www.lindeus.com

Linde Gas Puerto Rico, Inc.
Las Palmas Village
Road No. 869, Street No. 7
Catano, Puerto Rico 00962
Phone: 787-641-7445
www.pr.lindegas.com

Linde Canada Limited
5860 Chedworth Way
Mississauga, Ontario L5R 0A2
Phone: 905-501-1700
www.lindecanada.com

* May include subsidiaries or affiliate companies/divisions.

For additional product information contact your local customer service.

2. HAZARDS IDENTIFICATION

**DANGER!**

Emergency Overview

Flammable gas
May form explosive mixtures with air.
Harmful by inhalation
May cause skin, eye, and respiratory tract irritation
May cause central nervous system depression
Contents under pressure
Keep at temperatures below 52°C / 125°F

Appearance: Colorless
Physical State: Compressed gas.
Odor: Slight sweet
OSHA Regulatory Status

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Potential Health Effects

Principle Routes of Exposure
Eye contact. Skin contact. Inhalation.

Acute Toxicity

Inhalation
Harmful by inhalation. May cause irritation of respiratory tract. May cause central nervous system depression with nausea, headache, dizziness, vomiting, and incoordination. Odor will not provide sufficient warning of exposure. Potentially dangerous amounts may be inhaled before odor is detected.

Eyes
Irritating to eyes. Contact of longer duration and concentration can cause serious injury to the eyes, possibly blindness, due to formation of boric acid.

Skin
Irritating to skin.

Skin Absorption Hazard
No known hazard by skin absorption.

Ingestion
Not an expected route of exposure.

Chronic Effects
May cause adverse liver and kidney effects.

Aggravated Medical Conditions

Environmental Hazard
See Section 12 for additional Ecological Information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS-No</th>
<th>Volume %</th>
<th>Chemical Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>7727-37-9</td>
<td>98.4 - 99.2</td>
<td>N₂</td>
</tr>
<tr>
<td>Diborane</td>
<td>19287-45-7</td>
<td>&gt;= 0.8 - 1.6</td>
<td>B₂H₆</td>
</tr>
</tbody>
</table>

Additional information: Composition listed covers broad ranges rather than exact percentages for specific products.

4. FIRST AID MEASURES

General Advice
Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact
Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Call a physician immediately.

Skin Contact
Wash off immediately with soap and plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Get medical attention if irritation persists.

Inhalation
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF INHALATION OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious inhalation victims should be assisted to an uncontaminated area and inhale fresh air. If breathing is difficult, administer oxygen. Unconscious persons should be moved to an uncontaminated area and, as necessary, given artificial resuscitation and supplemental oxygen. Treatment should be symptomatic and supportive.

Ingestion
Not an expected route of exposure. Do NOT induce vomiting. Call a physician or Poison Control Center immediately. Never give anything by mouth to an unconscious person. Drink plenty of water.

Notes to Physician
Treat symptomatically.
Protection of First-aiders

Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. FIRE-FIGHTING MEASURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flammable Properties</strong></td>
<td>Extremely flammable. Diborane concentrations above 0.8% in Nitrogen are flammable. (CGA P-23 2008)</td>
</tr>
<tr>
<td><strong>Suitable Extinguishing Media</strong></td>
<td>It may be safer to allow the fire to burn itself out. Use water spray to knock down vapors and cool fire-exposed containers. DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.</td>
</tr>
<tr>
<td><strong>Unsuitable Extinguishing Media</strong></td>
<td>Do not use halogenated extinguishing agents or foam. Diborane reacts with these materials and will form shock sensitive and thermally sensitive materials.</td>
</tr>
<tr>
<td><strong>Hazardous Combustion Products</strong></td>
<td>Boron compounds.</td>
</tr>
<tr>
<td><strong>Explosion Data</strong></td>
<td>Due to the presence of Diborane, this mixture may become shock and thermally sensitive in the presence of impurities such as oxygen, water, halogenated hydrocarbons and other materials, when Diborane level is at its highest.</td>
</tr>
<tr>
<td><strong>Sensitivity to Mechanical Impact</strong></td>
<td>Yes.</td>
</tr>
<tr>
<td><strong>Specific Hazards Arising from the Chemical</strong></td>
<td>Diborane is pyrophoric, and may ignite spontaneously in moist air at room temperature, it may react violently with water to form hydrogen, and may accumulate and explode without ignition source. The heat of combustion from a diborane fire is greater than that from a similar hydrocarbon, such as ethane. Continue to cool fire exposed cylinders until flames are extinguished. Cylinders may rupture under extreme heat. Damaged cylinders should be handled only by specialists.</td>
</tr>
<tr>
<td><strong>Protective Equipment and Precautions for Firefighters</strong></td>
<td>If possible, stop the flow of gas. Do not extinguish the fire until supply is shut off as otherwise an explosive-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Ventilation fans must be explosion proof. Use non-sparking tools to close container valves. Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Additional chemical protective clothing may be required to protect from toxic decomposition products.</td>
</tr>
</tbody>
</table>

6. ACCIDENTAL RELEASE MEASURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Precautions</strong></td>
<td>ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. All equipment used when handling the product must be grounded. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.</td>
</tr>
<tr>
<td><strong>Environmental Precautions</strong></td>
<td>Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Prevent spreading of vapors through sewers, ventilation systems and confined areas.</td>
</tr>
<tr>
<td><strong>Methods for Containment</strong></td>
<td>Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.</td>
</tr>
</tbody>
</table>
Methods for Cleaning Up

Return cylinder to Linde or an authorized distributor.

Other Information

Ventilate the area.

7. HANDLING AND STORAGE

Handling

Ground and bond all lines and equipment associated with product system. All equipment should be non-sparking and explosion proof. Remove all sources of ignition. Use only in ventilated areas.

Handle this gas mixture only in sealed and purged systems. All areas where this gas mixture is used should be monitored with very sensitive gas detection instruments. Detection of concentrations below 50% of the PEL (0.1 ppm) of Diborane 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.

Never attempt to lift a cylinder by its valve protection cap. Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Use equipment rated for cylinder pressure. Use backflow preventive device in piping.

Use an adjustable strap wrench to remove over-tight or rusted caps. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never attempt to refill a compressed gas cylinder without the owner’s written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

Storage

Outside or detached storage is preferred. Protect from physical damage. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Keep at temperatures below 52°C / 125°F. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
<th>NIOSH IDLH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diborane 19287-45-7</td>
<td>TWA: 0.1 ppm</td>
<td>TWA: 0.1 ppm</td>
<td>IDLH: 15 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TWA: 0.1 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TWA: 0.1 ppm</td>
</tr>
</tbody>
</table>

ACGIH TLV: American Conference of Governmental Industrial Hygienists - Threshold Limit Value. OSHA PEL: Occupational Safety and Health Administration - Permissible Exposure Limits. NIOSH IDLH: Immediately Dangerous to Life or Health.

Other Exposure Guidelines

Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).
Engineering Measures
Showers. Eyewash stations. Explosion proof ventilation systems. Exhaust gas should be vented to a gas treatment system.

Ventilation
Use ventilation adequate to keep exposures below recommended exposure limits.

Personal Protective Equipment

Eye/Face Protection
Face-shield. Tightly fitting safety goggles.

Skin and Body Protection
Appropriate protective and chemical resistant gloves, clothing and splash protection, or fully encapsulating vapor protective clothing to prevent exposure. For materials of construction consult protective clothing manufacturer's specifications.

Respiratory Protection

General Use
If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Emergency Use
Use positive pressure air line respirator or self-contained breathing apparatus for exposure over exposure limits or emergency use. For exposures above IDLH, an additional escape bottle is required.

Hygiene Measures
Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing before re-use. Provide regular cleaning of equipment, work area and clothing. Keep away from food, drink and animal feeding stuffs. Avoid contact with skin, eyes and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Product Information

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Colorless.</th>
<th>Odor</th>
<th>Slight sweet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odor Threshold</td>
<td>2.5 ppm (Diborane)</td>
<td>Physical State</td>
<td>Compressed gas</td>
</tr>
<tr>
<td>Flash Point</td>
<td>No information available.</td>
<td>Autoignition Temperature</td>
<td>36°C / 100°F (Diborane)</td>
</tr>
<tr>
<td>Flammability Limits in Air</td>
<td>(For Diborane)</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>0.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following information is for the NON-INERT components of this mixture:

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Boiling Point</th>
<th>Melting Point</th>
<th>Molecular Weight</th>
<th>Evaporation Rate</th>
<th>Water Solubility</th>
<th>Vapor Pressure</th>
<th>Vapor Density (Air=1)</th>
<th>Gas Density Kg/m³@20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diborane</td>
<td>-93 °C</td>
<td>-165 °C</td>
<td>27.69</td>
<td>-</td>
<td>No information available</td>
<td>224 mmHg @ -112 °C</td>
<td>1.0</td>
<td>1.159</td>
</tr>
</tbody>
</table>

The following information is for the INERT components that may be part of this mixture:

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Boiling Point</th>
<th>Melting Point</th>
<th>Molecular Weight</th>
<th>Evaporation Rate</th>
<th>Water Solubility</th>
<th>Vapor Pressure</th>
<th>Vapor Density (Air=1)</th>
<th>Gas Density Kg/m³@20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>-196 °C</td>
<td>-210 °C</td>
<td>26.01</td>
<td>-</td>
<td>0.023 (vol/vol @ 20°C and 1 atm)</td>
<td>Above critical temperature</td>
<td>0.97</td>
<td>1.165</td>
</tr>
</tbody>
</table>

10. STABILITY AND REACTIVITY
10. STABILITY AND REACTIVITY

Stability
Unstable at elevated temperatures. Diborane mixture storage time should be minimized.

Incompatible Products

Conditions to Avoid
Heat, flames and sparks. Exposure to air or moisture over prolonged periods.

Hazardous Decomposition Products
Hydrogen, higher boranes at room temperature.

Hazardous Polymerization
Diborane will polymerize to form liquid pentaborane. No information was available for reaction rate.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity
Product Information
LD50 Oral: No information available.
LD50 Dermal: No information available.
LC50 Inhalation: Refer to CGA P-20 for classification procedures for toxic gas mixtures.
Repeated Dose Toxicity No information available.

Component Information

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>LD50 Oral</th>
<th>LD50 Dermal</th>
<th>LC50 Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diborane</td>
<td></td>
<td></td>
<td>Per CGA P-20: 80 ppm (Rat) time adjusted</td>
</tr>
</tbody>
</table>

Chronic Toxicity

Chronic Toxicity May cause adverse liver and kidney effects.
Carcinogenicity Contains no ingredient listed as a carcinogen.

Irritation No information available.
Sensitization No information available.
Reproductive Toxicity No information available.
Developmental Toxicity No information available.
Synergistic Materials None known.

12. ECOLOGICAL INFORMATION

Ecotoxicity
12. ECOLOGICAL INFORMATION

The environmental impact of this product has not been fully investigated.

Ozone depletion potential, ODP; \(R-11 = 1\): Does not contain ozone depleting chemical (40 CFR Part 82).

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods
Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Linde for proper disposal.

Contaminated Packaging
Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT
Proper shipping name
Compressed gas, flammable, n.o.s.
Hazard Class
2.1
Subsidiary Class
None
UN-Number
UN1954
Packing Group
None
Description
UN1954, Compressed gas, flammable, n.o.s. (Diborane, Nitrogen), 2.1
Emergency Response Guide Number
115

TDG
Proper Shipping Name
Compressed gas, flammable, n.o.s.
Hazard Class
2.1
UN-Number
UN1954
Description
UN1954, COMPRESSED GAS, FLAMMABLE, N.O.S. (Diborane, Nitrogen), 2.1

MEX
Proper Shipping Name
Compressed gas, flammable, n.o.s.
Hazard Class
2.1
UN-Number
UN1954
Description
UN1954 Compressed gas, flammable, n.o.s. (Diborane, Nitrogen), 2.1

IATA
UN-Number
UN1954
Proper Shipping Name
Compressed gas, flammable, n.o.s.
Hazard Class
2.1
ERG Code
10L
Description
UN1954, Compressed gas, flammable, n.o.s. (Diborane, Nitrogen), 2.1
Maximum Quantity for Passenger
Forbidden
Maximum Quantity for Cargo Only
150 kg
Limited Quantity
Forbidden

IMDG/IMO
Proper Shipping Name
Compressed gas, flammable, n.o.s.
Hazard Class
2.1
UN-Number
UN1954
EmS No.
F-D, S-U
15. REGULATORY INFORMATION

International Inventories

<table>
<thead>
<tr>
<th>Legend</th>
<th>TSCA</th>
<th>DSL</th>
<th>EINECS/ELINCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSCA - United States Toxic Substances Control Act Section 8(b) Inventory</td>
<td>Complies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List</td>
<td></td>
<td>Complies</td>
<td></td>
</tr>
<tr>
<td>EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances</td>
<td></td>
<td></td>
<td>Complies</td>
</tr>
</tbody>
</table>

U.S. Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

| Acute Health Hazard | Yes |
| Chronic Health Hazard | No |
| Fire Hazard | Yes |
| Sudden Release of Pressure Hazard | Yes |
| Reactive Hazard | Yes |

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Risk and Process Safety Management Programs
This material, as supplied, contains one or more regulated substances with specified thresholds under 40 CFR Part 68 or regulated as a highly hazardous chemical pursuant to the 29 CFR Part 1910.110 with specified thresholds:

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances</th>
<th>U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances</th>
<th>U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diborane</td>
<td>2500 lbs</td>
<td></td>
<td>100 lb</td>
</tr>
</tbody>
</table>

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)
This product does not contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act Amendments of 1990.
CERCLA/SARA
This material, as supplied, contains one or more substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355):

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Hazardous Substances RQs</th>
<th>Extremely Hazardous Substances RQs</th>
<th>TPQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diborane</td>
<td></td>
<td>100 lb</td>
<td>100 lb TPQ</td>
</tr>
</tbody>
</table>

U.S. State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Massachusetts</th>
<th>New Jersey</th>
<th>Pennsylvania</th>
<th>Illinois</th>
<th>Rhode Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Diborane</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

International Regulations

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Carcinogen Status</th>
<th>Exposure Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diborane</td>
<td></td>
<td>Mexico: TWA= 0.1 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mexico: TWA= 0.1 ppm</td>
</tr>
</tbody>
</table>

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
A Compressed gases
B1 Flammable gas
D2B Toxic materials

16. OTHER INFORMATION

Prepared By Product Stewardship
23 British American Blvd.
Latham, NY 12110
1-800-572-6501

Issuing Date 10-Feb-2011

Revision Date

Revision Number 0
Revision Note

Initial Release.

<table>
<thead>
<tr>
<th>NFPA</th>
<th>Health Hazard</th>
<th>Flammability</th>
<th>Stability</th>
<th>Physical and Chemical Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>W</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HMIS</th>
<th>Health Hazard</th>
<th>Flammability</th>
<th>Physical Hazard</th>
<th>Personal Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

General Disclaimer

For terms and conditions, including limitation of liability, please refer to the purchase agreement in effect between Linde LLC, Linde Merchant Production, Inc. or Linde Gas North America LLC (or any of their affiliates and subsidiaries) and the purchaser.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user’s intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

End of Safety Data Sheet