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P.O. BOX 94737
CLEVELAND, OH 44101-4737

MATERIAL
SAFETY
DATA SHEET
No. 49

PRODUCT NAME
Nitrogen, Refrigerated Liquid

TRADE NAME AND SYNONYMS
Nitrogen, refrigerated liquid (D.O.T.); LIN; Liquid Nitrogen

CHEMICAL NAME AND SYNONYMS
Liquid or Liquefied Nitrogen

ISSUE DATES AND REVISIONS
Revised January 1995

CAS #
7727-37-9

DOT/I.D. No.
UN 1977

DOT Hazard Class
Division 2.2

Formula
Liquefied N2

Chemical Family
Inert

HEALTH HAZARD DATA

1986 WEIGHTED AVERAGE EXPOSURE LIMIT
Nitrogen is defined as a simple asphyxiant (ACGIH 1994-1995); OSHA 1993 PEL (8 Hr. TWA) = None listed.
(Continued on Page 4)

SYMPTOMS OF EXPOSURE
Effects of exposure to high concentrations so as to displace the oxygen in air necessary for life may include any, all or none of the following:

• Loss of balance or dizziness
• Tightness in the frontal area of the forehead  (Continued on Page 4)

TOXICOLOGICAL PROPERTIES
Nitrogen is nontoxic but the liberation of a large amount in a confined area could displace the amount of oxygen in air necessary to support life.

Frostbite effects are a change in color of the skin to gray or white possibly followed by blistering.

Nitrogen is not listed in the IARC, NTP or by OSHA as a carcinogen or potential carcinogen.  (Continued on Page 4)

RECOMMENDED FIRST AID TREATMENT
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO NITROGEN.
RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted respiration and supplemental oxygen. Further treatment should be symptomatic and supportive.

Dermal Contact or Frostbite: Flush affected areas with lukewarm water. DO NOT USE HOT WATER. A physician should see the patient promptly if the cryogenic "burn" has resulted in blistering of the dermal surface or deep tissue freezing.

Information contained in this material safety data sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition of matter or use.
Since the Company shall have no control of the use of the product described herein, the Company assumes no liability for loss or damage incurred from the proper or improper use of such product.
NITROGEN, REFRIGERATED LIQUID

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES
Flammable over an extremely wide range in air. Explosive reactions may occur on ignition. Reacts explosively with halogens and halogenated compounds.

<table>
<thead>
<tr>
<th>PHYSICAL DATA</th>
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</thead>
<tbody>
<tr>
<td>SOILING POINT</td>
</tr>
<tr>
<td>LIQUID DENSITY AT SOILING POINT</td>
</tr>
<tr>
<td>VAPOR PRESSURE</td>
</tr>
<tr>
<td>GAS DENSITY AT 70°F, 1 atm</td>
</tr>
<tr>
<td>SOLUBILITY IN WATER</td>
</tr>
<tr>
<td>FREEZING POINT</td>
</tr>
<tr>
<td>EVAPORATION RATE</td>
</tr>
<tr>
<td>SPECIFIC GRAVITY (Air=1)</td>
</tr>
<tr>
<td>APPEARANCE AND ODOR</td>
</tr>
</tbody>
</table>

FIRE AND EXPLOSION HAZARD DATA

<table>
<thead>
<tr>
<th>FLASH POINT (Method used)</th>
<th>AUTO IGINITION TEMPERATURE</th>
<th>FLAMMABLE LIMITS % BY VOLUME (See Page 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>LEL N/A, UEL N/A</td>
</tr>
</tbody>
</table>

EXTINGUISHING MEDIA
Nonflammable, inert

SPECIAL FIRE FIGHTING PROCEDURES
If liquid cylinders are involved in a fire, safely relocate or keep cool with water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS
None

REACTIVITY DATA

<table>
<thead>
<tr>
<th>STABILITY</th>
<th>CONDITIONS TO AVOID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable</td>
<td>X</td>
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</tbody>
</table>

INCOMPATIBILITY (Materials to avoid)
None

HAZARDOUS DECOMPOSITION PRODUCTS
None

HAZARDOUS POLYMERIZATION
May Occur

<table>
<thead>
<tr>
<th>CONDITIONS TO AVOID</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>WILL NOT OCCUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
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</tbody>
</table>

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
See Note on Page 4

WASTE DISPOSAL METHOD
See Note on Page 4
NITROGEN, REFRIGERATED LIQUID

SPECIAL PROTECTION INFORMATION

<table>
<thead>
<tr>
<th>RESPIRATORY PROTECTION</th>
<th>LOCAL EXHAUST</th>
<th>VENTILATION</th>
<th>MECHANICAL (Gen.)</th>
<th>SPECIAL</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Specify type)</td>
<td>See Page 4</td>
<td>See Local Exhaust</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

PROTECTIVE GLOVES
Loose fitting, insulated

EYE PROTECTION
Safety goggles or glasses plus face shield

OTHER PROTECTIVE EQUIPMENT
Safety shoes

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION
DOT Shipping Name: Nitrogen, refrigerated liquid
DOT Hazard Class: Division 2.2
DOT Shipping Label: Nonflammable Gas
I.D. No.: UN 1977

SPECIAL HANDLING RECOMMENDATIONS
See Note on Page 4 re Spill or Leak Procedures
For additional storage recommendations, consult Compressed Gas Association's Pamphlets P-9, P-12, P-14, and Safety Bulletin SB-2.

SPECIAL STORAGE RECOMMENDATIONS
See Note on Page 4 re Spill or Leak Procedures
For additional handling recommendations, consult Compressed Gas Association's Pamphlets P-9, P-12, P-14, and Safety Bulletin SB-2.

SPECIAL PACKAGING RECOMMENDATIONS
Liquid nitrogen cannot be handled in carbon or low alloy steels. Eighteen-eighth and 18-10 stainless steels are acceptable as are copper and its alloys, nickel and its alloys, brass, bronze, silicon alloys, Monel®, Inconel®, and beryllium.
Also see Compressed Gas Association's Pamphlets P-9, P-12, P-14, and Safety Bulletin SB-2.

OTHER RECOMMENDATIONS OR PRECAUTIONS
Liquefied gas cylinders should not be refilled except by qualified producers of these products. Shipment of a compressed gas container which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR). (Continued on Page 4)

*Various Government Agencies (i.e. Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.
NITROGEN, REFRIGERATED LIQUID

HEALTH HAZARD DATA

NOTE: Except where specified, the health hazard data and most of the other data in this Material Safety Data Sheet are for gaseous nitrogen. One volume of liquid nitrogen at its boiling point and atmospheric Pressure will vaporize into approximately 695 volumes of gaseous nitrogen at 70°F (21.1°C) and 1 atmosphere.

TIME WEIGHTED AVERAGE EXPOSURE LIMIT: (Continued)

Oxygen levels should be maintained at greater than 18 Molar percent at normal atmospheric pressure (pO2= 135 torr).

SYMPTOMS OF EXPOSURE: (Continued)

- Tingling of the tongue, fingertips or toes
- Weakened speech leading to the inability to utter sounds
- Rapid reduction in the ability to perform movements
- Reduced consciousness of the surroundings
- Loss of tactile sensations
- Heightened mental activity

It should be recognized that it is possible that none of the above symptoms may occur in nitrogen asphyxia so that there are no definite warning symptoms.

Contact with the cryogenic liquid or cold piping containing the liquid can cause tissue freezing or frostbite on dermal contact or if splashed into the eyes.

TOXICOLOGICAL PROPERTIES: (Continued)

Persons in ill health where such illness would be aggravated by exposure to nitrogen should not be allowed to work with or handle this product.

NOTE re SPILL OR LEAK PROCEDURES:

Liquid nitrogen is delivered to a customer into stationary vacuum-jacketed vessels at the customer's location or in portable vacuum-jacketed "liquid" cylinders.

Stationary customer-site vessels should be operated in accordance with the manufacturer’s and your supplier’s instructions. Do not attempt to repair, adjust, or in any other way modify the operation of these vessels. If there is a malfunction or other type of operational problem with the vessel, contact the closest supplier location immediately.

Liquid nitrogen cylinders should be used only in well-ventilated areas and in accordance with the manufacturer's and your supplier's instructions. These cylinders must always be kept in an upright position. Specialized hand trucks are needed for their movement. A "first in - first out" inventory system should be used with these cylinders.

SPECIAL PROTECTION INFORMATION

LOCAL EXHAUST:

To prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 18 molar percent.

SPECIAL PRECAUTIONS

OTHER RECOMMENDATIONS OR PRECAUTIONS: (Continued)

Always secure cylinders in an upright position before transporting them. NEVER transport cylinders in trunks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport cylinders secured in open flatbed or in open pick-up type vehicles. Reporting under SARA, Title III, Section 313 not required. NFPA 704 No for liquid nitrogen = 3 0 0 None