

MATERIAL SAFETY DATA SHEET

NITROGEN, REFRIGERATED LIQUID

1. PRODUCT AND COMPANY INFORMATION

Product: Liquid Nitrogen
Trade Name: Liquid Nitrogen
Chemical Name: Nitrogen
Common Name: Liquefied Nitrogen
Formula: N₂
Manufacturer's Name: Ferus Inc.
Manufacturer's Address: Suite 916-401-9 Avenue S.W.
Calgary, Alberta Canada T2P-3C5
Supplier's Name: Ferus Inc.
Supplier's Address: Suite 916-401-9 Avenue S.W.
Calgary Alberta Canada T2P-1G9

24 Hr Emergency Phone Numbers: Ferus Inc. 1-403-340-2990
Toll Free 1-877-923-3787
CANUTEC (collect) 1-613-996-6666

Production Identification Number: UN 1977
WHMIS Classification: A
TDG Classification: 2.2

2. COMPOSITION/INFORMATION ON INGREDIENTS

EXPOSURE LIMITS¹:

INGREDIENT	% VOLUME	8-HOUR OCCUPATIONAL EXPOSURE LIMIT ²	15-MINUTE or CEILING (c) OCCUPATIONAL EXPOSURE LIMIT ²	LD(50) (Route-Species)	LC(50) (Route-Species)
Nitrogen CAS: 7727-37-9	>99%	Simple Asphyxiant	Simple Asphyxiant	N/A	N/A

¹ Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As listed in the Occupational Health and Safety Act, Regulation and Code of Alberta under OHS Code Schedule 1 (Table 2 Occupational exposure limits for chemical substances).

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER! Odourless, colourless, non-flammable gas. Simple Asphyxiant – This product does not contain oxygen and may cause asphyxia if released in a confined area. Maintain oxygen levels above 19.5%. Contents under pressure. Contact with product may cause frostbite or freezing burns to exposed tissues. Use and store below 52°C. Self-Contained Breathing Apparatus and appropriate protective clothing may be required by rescue workers.

4. FIRST AID MEASURES

GENERAL: Always remove victim(s) from the source of contamination. Take a copy of label and MSDS to physician or other health professional with victim(s).

EYES: Never introduce ointment or oil into the eyes without medical advice! In case of freezing or cryogenic “burns” caused by rapidly evaporating liquid, **DO NOT WASH THE EYES WITH HOT OR EVEN TEPID WATER!** Remove victim from the source of contamination. Open eyelids wide to allow liquid to evaporate. If pain is present, refer the victim to an ophthalmologist for treatment and follow up. If the victim cannot tolerate light, protect the eyes with a light bandages. Do not apply any pressure.

SKIN: For dermal contact or frostbite: Remove contaminated clothing and 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.

INGESTION: A physician should see the patient promptly if the cryogenic “burn” has resulted in blistering of the dermal surface or deep freezing.

INHALATION: PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Victims should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious person should be moved to an uncontaminated area, and if breathing has stopped, administer artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

5. FIRE OR EXPLOSION HAZARDS

FLASH POINT (test method): Not applicable.

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AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS IN AIR: LOWER: Not applicable. **UPPER:** Not applicable.

CONDITIONS OF FLAMMABILITY: Nitrogen is non flammable product and will not burn. Heat of fire can build up pressure in cylinders and vessels causing them to rupture. No part of the container should be subjected to a temperature higher than 52°C. Liquid Nitrogen containers are equipped with pressure relief devices to avoid rupture.

EXTINGUISHING MEDIA: Nitrogen cannot catch fire therefore; use the appropriated media for the surrounding area. Nitrogen will expand within the container as it is heated and begin to vent gas through the venting device. Responders may cool the container with water ensuring not to spray directly into the venting devices or product as the water will freeze rapidly and compromise the operation of the venting devices.

SPECIAL FIRE FIGHTING PROCEDURES:

WARNING! Extremely cold liquid and gas under pressure

Evacuate all personnel from danger area. Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Immediately spray containers with water from maximum distance until cool, taking care not to direct spray into vents on top of containers. Do not discharge sprays into liquid nitrogen; it will freeze water rapidly. Shut off flow if you can do so without risk. Self-contained breathing apparatus may be required by rescue workers.

HAZARDOUS COMBUSTION PRODUCTS: Not applicable.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not applicable.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not applicable.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

WARNING! Extremely cold liquid and gas under pressure. Asphyxiant. Lack of oxygen can kill. Evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Liquid causes severe frostbite, a burn like injury. Shut off flow if you can do so without risk. Avoid contact with spilled liquid and allow it

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to evaporate. Ventilate area of leak or move container to a well-ventilated area. Test for sufficient oxygen, especially in confined spaces ensuring at least 19.5% oxygen in the atmosphere, before allowing reentry.

7. HANDLING AND STORAGE

ELECTRICAL CLASSIFICATION: Non-hazardous.

This liquefied gas is non-corrosive and may be used with all common structural materials. Use only in well-ventilated areas. Use a pressure reducing regulator when connecting cylinder to lower pressure piping or systems. Do not heat cylinder or vessels by any means to increase the discharge rate of product.

Stationary customer site vessels should be operated in accordance with the manufacturer's and Ferus'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 operations problem with the vessel, contact the closest Ferus location immediately for assistance.

Liquid Nitrogen is delivered into stationary vacuum jacketed vessels at the customer's location. Consult manufacturer's instructions.

STORAGE PRECAUTIONS: Store and use with adequate ventilation. Do not store at temperatures exceeding 52°C. Do not store in a confined space or near sources of heat, ignition and direct sunlight. Also ensure containers are not in a heavily trafficked area or near an emergency exit. Cryogenic containers are equipped with a pressure relief device and a pressure controlling valve. Under normal condition, these containers will periodically vent product. Use adequate pressure relief devices in systems and piping to prevent pressure buildup; entrapped liquid can generate extremely high pressures when vaporized by warming.

HANDLING PRECAUTIONS: Never allow any unprotected part of your body to touch un-insulated pipes or vessels containing cryogenic fluids. Flesh will stick to the extremely cold metal and will tear when you try to pull free. Use the properly specific, rated, tested and certified equipment when handling or working near the product. Only use transfer lines designed and compatible for cryogenic use.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST – Use a local exhaust system, if necessary, to prevent oxygen deficiency. Oxygen levels should be maintained above 19.5%.

MECHANICAL (general) – General exhaust ventilation may be acceptable if it can maintain an adequate supply of air.

SPECIAL – None.

OTHER – None.

EYE/FACE PROTECTION: CSA (standard Z94.3-99 or Z94.3-02) approved safety glasses and full face shields are required to be utilized at all times when working with and / or around this product.

SKIN PROTECTION: Protective gloves of any material appropriate for the job. Insulated gloves are recommended for cryogenic liquids as well as long sleeve shirts and trousers.

RESPIRATORY PROTECTION: Use air supplied respirators where local or general exhaust ventilation is inadequate. CSA (standard Z94.4-02) approved supplied air/self contained air respirators must be used in confined spaces, oxygen deficient atmospheres and rescue situations where oxygen levels are below 19.5%.

OTHER/GENERAL PROTECTION: Safety shoes.

9. PHYSICAL AND CHEMICAL DATA

Parameter	Value	Units
PHYSICAL STATE	Liquid	-
MOLECULAR WEIGHT	28.01	g/mol
SPECIFIC GRAVITY (Air = 1)(1.1013 bar and 21°C)	0.967	-
VAPOUR PRESSURE (at 20°C)	N/A	bar
LIQUID DENSITY (at 21.1°C)	808.607	kg/m ³
VAPOR DENSITY (at 21.1°C)	1.153	kg/m ³
EVAPORATION RATE (nBuAc=1)	N/A	-
BOILING POINT	-195.86	°C
FREEZING POINT	-209.95	°C
pH:	N/A	-
COEFFICIENT WATER/OIL DISTRIBUTION(Gas @ 15°C)	N/A	-
SPECIFIC VOLUME (1.013 bar and 21 °C)	0.862	m ³ /kg

ODOUR AND APPEARANCE: Liquid Nitrogen is a colorless, odorless cryogenic liquid.

ODOUR THRESHOLD: Not applicable. Odorless.

10. REACTIVITY AND STABILITY DATA

CHEMICAL STABILITY: Normally stable in gaseous state. With cryogenic liquid, when exposed to air, oxygen in the air may condense into the Liquid Nitrogen. Liquid Nitrogen contaminated with oxygen may present the same hazards as Liquid Oxygen and could react violently with organic materials, such as oil and grease.

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INCOMPATIBLE MATERIALS: Titanium is the only element that will burn in Nitrogen. Lithium reacts slowly with Nitrogen at ambient temperatures. Also, use of Liquid Nitrogen in cryogenic grinding of fatty materials can lead to an explosion. If Liquid Nitrogen and magnesium powder are mixed a very violent reaction will occur when lit with a fuse, forming magnesium nitride.

CONDITIONS OF REACTIVITY TO AVOID: Non-reactive at low and ambient temperature. Contact with incompatible materials. Exposure of cryogenic containers to high temperatures or direct flame can cause the container to rupture or burst. Liquid spillage can cause embrittlement of Non-cryogenic metals.

HAZARDOUS DECOMPOSITION PRODUCTS: None known.

11. TOXICOLOGICAL INFORMATION

Nitrogen is a non-toxic, simple asphyxiant. Initially stimulates respiration and then causes respiratory depression. High concentrations result in narcosis. Symptoms in humans are as follows:

ROUTES OF ENTRY: The most significant routes of over-exposure for this gas are by inhalation, and contact with the cryogenic liquid.

-INHALATION: Nitrogen being an asphyxiant, high concentrations of this gas can cause an oxygen-deficient environment. An individual breathing in this atmosphere may experience symptoms which include headaches, ringing in the ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur.

-SKIN CONTACT: Skin coming contact with the liquid can result in severe cryogenic burns or dermatitis (red, cracked irritated skin), depending upon concentration and duration of exposure. Contact with the undiluted liquid will cause frostbite, ulceration of the skin (which may be delayed in appearance for several hours), blistering and pain.

-INGESTION: None.

-EYE CONTACT: Contact of the liquid with the eyes can cause pain, redness, severe cryogenic burns and prolonged exposure could cause blindness.

EFFECTS OF ACUTE EXPOSURE TO PRODUCT: The main health hazard associated with the release of Nitrogen gas is the inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, headache, dizziness and nausea. The skin of a victim of over-exposure may have a blue color. At high concentrations, unconsciousness or death may occur. Also, contact with cryogenic liquid or rapidly expanding gases may cause frostbite. Frostbite may cause the affected area to turn white or grayish-yellow.

EFFECTS OF CHRONIC EXPOSURE TO PRODUCT: Chronic exposure to oxygen deficient atmospheres (below 18% oxygen) may affect the heart and nervous system.

OTHER EFFECTS OF OVEREXPOSURE: Not available.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known.

TERATOGENICITY: Nitrogen is not reported to cause teratogenic effects in humans.

CARCINOGENICITY: Nitrogen is not carcinogenic.

MUTAGENICITY: Nitrogen is not reported to cause mutagenic effects in humans.

REPRODUCTIVE TOXICITY: Not listed.

IRRITANCY OF PRODUCT: Contact with the cryogenic liquid or rapidly expanding gases can cause frostbite and damage to exposed skin and eyes.

SENSITIZATION TO PRODUCT: Nitrogen is not a sensitizer.

NAME OF TOXIOLOGICAL SYNERGISTIC PRODUCTS: None.

12. ECOLOGICAL INFORMATION

Nitrogen is naturally occurring in the atmosphere. No adverse ecological effects expected. Nitrogen does not contain any Class I or Class II ozone depleting chemicals. Liquid spills have caused frost damage to vegetation. Nitrogen is not listed as a marine pollutant by DOT.

13. DISPOSAL CONSIDERATIONS

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.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Nitrogen, refrigerated liquid
SHIPPING LABEL(S):	Non-flammable, non-corrosive, non-poisonous gas
PRIMARY CLASS:	2.2
PACKING GROUP:	N/A
UN NUMBER:	1977
ERG (2004) NUMBER:	120

SPECIAL TRANSPORT INFORMATION: Containers should be in a secure position when transported, and in a well-ventilated vehicle. Containers transported in an enclosed, non-ventilated vehicle can present a serious safety hazard.

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OTHER TRANSPORT INFORMATION: Ensure that drivers are aware of load characteristics, and through TDG training, know what to do in the event of an accident or emergency. Ensure all shipment are moved within applicable regulations.

15. REGULATORY INFORMATION

WHMIS CLASSIFICATION:

A (compressed gas)



HMIS RATINGS:

- 0 = Minimal Hazard
- 1 = Slight Hazard
- 2 = Moderate Hazard
- 3 = Serious Hazard
- 4 = Severe Hazard

HEALTH HAZARD	(Blue)	3
FLAMMABILITY HAZARD	(Red)	0
PHYSICAL HAZARD	(Yellow)	2

CANADIAN DOMESTIC SUBSTANCES LIST: Nitrogen is listed on the DSL inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT: Nitrogen is not listed on the CEPA priorities substances list.

OTHER CANADIAN REGULATIONS: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

U.S. TOXIC SUBSTANCE CONTROL ACT: Nitrogen is listed on the US Toxic Substances Control Act (TSCA) inventory.

OTHER U.S. FEDERAL REGULATIONS: Not applicable.

16. OTHER INFORMATION

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(2) Ferus Inc. 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.