

Nitrogen, Refrigerated Liquid Safety Data Sheet

Ferus Inc.

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NITROGEN, REFRIGERATED LIQUID

SAFETY DATA SHEET

1. PRODUCT AND COMPANY INFORMATION

Product: Nitrogen, Refrigerated Liquid

Manufacturer's Name: Ferus Inc.
Manufacturer's Address: SE 09-24-23-W4, Wheatland County, AB
NE 25-38-26-W4, Lacombe County, AB
2601-92 Ave, Dawson Creek, BC

Supplier's Name: Ferus Inc.
Supplier's Address: Suite 1220, 401-9th Ave SW
Calgary, Alberta Canada T2P 3C5

24 Hr Emergency Phone Numbers:

Ferus Canada	1-877-923-3787
Ferus USA	1-855-903-3787
CANUTEC	1-613-996-6666

RECOMMENDED USES:

Refrigerant for cryopulverization; cryogenic agent in stainless steel deformation (as liquid); cryogenic bearing lubricant in rocket propulsion systems; inert gas in chemical processing; inert atmosphere; inert liquid to remove impurities on electronic components; diluent to control reaction rates in polymer processing; pressure stabilizer in enhanced oil/natural gas recovery.

Used in many industries as an inert medium for various chemical reactions, for the pumping and transfer of combustible liquids, for the measurement of high temperatures and for the purging of pipes and vessels that have contained chemicals.

2. HAZARDS IDENTIFICATION

Production Identification Number: UN 1977
WHMIS Classification: A – Compressed Gas
Class: 2 – Gases
Division: 2.2 – Non-flammable, non-toxic gases

WHMIS CLASSIFICATION:



A (Compressed Gas)

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NFPA 704 RATING:

HEALTH HAZARD	(Blue - left)	3
FLAMMABILITY HAZARD	(Red - top)	0
PHYSICAL HAZARD	(Yellow - right)	0
OTHER	(White - bottom)	N/A



WARNING!

Cold liquid and gas under pressure. Container may explode if heated. Use and store below 51.1°C (125°F).

Vapours may cause dizziness or asphyxiation without warning.

When in contact with refrigerated liquids, many materials become brittle and are likely to break without warning.

Exposure to nitrogen (including vapour) and resulting hypoxia may result in:

- Increased respiration and heart rate
- Dizziness and / or drowsiness
- Suffocation without warning
- Frostbite

Maintain oxygen levels above 19.5%.

All early effects may decrease ability for self-rescue from the toxic environment.

SUMMARY OF EXPOSURE (ACUTE EXPOSURE): Simple asphyxiants are inert gases or vapours that displace oxygen from the air and as such may result in hypoxia. Four stages are described, depending on the arterial oxygen saturation.

- 1.) INDIFFERENT STAGE (Oxygen saturation: 90%):** Decreased night vision
- 2.) COMPENSATORY STAGE (Oxygen saturation: 82% to 90 %):** Compensatory increase in respiratory rate, compensatory increase in heart rate, night vision is decreased further, mildly reduced performance ability, mildly reduced alertness, other symptoms may develop in those with significant preexisting cardiac, pulmonary, or hematologic diseases
- 3.) DISTURBANCE STAGE (Oxygen saturation: 64% to 82%):** Compensatory mechanisms become inadequate, air hunger, fatigue, tunnel vision, dizziness, headache, belligerence, euphoria, reduced visual acuity, numbness and tingling of extremities, hyperventilation, poor judgment, memory loss, cyanosis, decreased ability for escape from toxic environment
- 4.) CRITICAL STAGE (Oxygen saturation: 60% to 70% or less):** Deterioration in judgment and coordination may occur in 3 to 5 minutes or less, total incapacitation and unconsciousness follow rapidly

CARDIOVASCULAR (ACUTE EXPOSURE): An increased pulse rate may occur. Cardiac manifestations of prolonged or severe hypoxia may include atrial or ventricular

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dysrhythmias, hypotension, myocardial ischemia, myocardial infarction, and eventual asystole. "Sudden sniffing death", or cardiac arrest, has been reported following intentional inhalation of hydrocarbons.

RESPIRATORY (ACUTE EXPOSURE): Hyperventilation may develop. Cyanosis may occur. Bronchoconstriction and respiratory depression may be seen. Pulmonary edema and lung congestion may occur.

NEUROLOGIC (ACUTE EXPOSURE): Various disturbances including headache, dizziness, mood disturbances, numbness of the extremities, sleepiness, mental confusion, poor judgment and coordination, and memory loss may occur. Prolonged or severe hypoxia has resulted in unconsciousness. Prolonged asphyxia may produce CNS injury. Hemiparesis has been reported with volatile substance abuse. Cerebral edema with brainstem herniation may occur. Seizures have been reported following intentional inhalation.

GASTROINTESTINAL (ACUTE EXPOSURE): Nausea, vomiting, and gastrointestinal hemorrhage may develop.

ACID-BASE (ACUTE EXPOSURE): Not Applicable.

DERMATOLOGIC (ACUTE EXPOSURE): Dermal exposure may cause frostbite injury. Severe tissue burns have been reported.

MUSCULOSKELETAL (ACUTE EXPOSURE): Rhabdomyolysis and seizures have been reported.

REPRODUCTIVE HAZARDS: Sequelae of oxygen deprivation in the unborn are controversial. Cerebral palsy, previously thought to be due to acute hypoxia during labor and/or childbirth, remains poorly understood.

CARCINOGENICITY: 7727-37-9 is not listed as a carcinogen (IARC, 2004).

3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS RN	CONCENTRATION
Nitrogen	7727-37-9	99.9%

Trade Name:	Nitrogen, Refrigerated Liquid
Chemical Name:	Nitrogen
Common Name:	Nitrogen, Cryogenic Liquid
Formula:	N ₂

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4. FIRST AID MEASURES

GENERAL: Remove the victim from the source of contamination. Medical attention should be prompt in all cases of over-exposure to Nitrogen. Rescue personnel should be equipped with Self-Contained Breathing Apparatus. Also note that there is no specific antidote and treatment of over-exposure should be directed at the control of symptoms and the clinical condition. Take a copy of the label and SDS to physician or other health professional with victim(s).

EYES: Remove victim from the source of contamination. Never introduce oil or ointment into the eyes without medical advice. Irrigate exposed eyes with copious amounts of room temperature water for at least 15 minutes. If the victim cannot tolerate light, protect eyes with dark glasses. The use of bandages is not recommended for keeping the eyelids closed as exerting pressure on the eyelid may cause further damage. If irritation, pain, swelling, or other symptoms persist, the patient should be seen by a health care physician.

SKIN: Clothing frozen to the skin should be thawed prior to removal. Remove contaminated clothing and flush affected area with lukewarm water. **DO NOT USE HOT WATER.** Keep victim warm and quiet. A physician should see the patient promptly if frostbite has occurred.

INGESTION: A physician should see the patient promptly if frostbite has occurred.

INHALATION: RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Quick removal from the contaminated area is most important. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Unconscious persons should be moved to an uncontaminated area, given assisted resuscitation and supplemental oxygen. **PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO NITROGEN.** Further treatment should be symptomatic and supportive.

5. FIREFIGHTING MEASURES

SPECIAL CONSIDERATIONS: Non-combustible gas. Heat from a fire can build pressure in containers and cause them to rupture. No part of a container should be subjected to a temperature higher than 51.1°C (125°F). Liquid Nitrogen containers are equipped with pressure relief devices. If tank, rail car or tank truck is involved in a fire, isolate for 800 meters (1/2 mile) in all directions.

FIRE FIGHTING: Self-contained breathing apparatus with a full face-piece operated in pressure-demand or other positive pressure mode. Do not discharge sprays into liquid nitrogen; it will freeze water rapidly. Shut off flow of nitrogen if possible without risk.

IF MATERIAL IS ON FIRE OR INVOLVED IN FIRE: Material itself does not burn or burns with difficulty. Extinguish fire using agent suitable for type of surrounding fire.

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Cool affected containers with flooding quantities of water. Do not use water on material itself or near pressure relief devices. Apply water from as far a distance as possible.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: CAUTION! High-pressure gas. Large spill – evacuate for at least 100 meters (330 feet) in all directions. Use appropriate protective clothing and wear a Self-Contained Breathing Apparatus when entering the area. Shut off the flow of product if safe to do so. Ventilate area or move the container to a well-ventilated area. Test for sufficient oxygen and ensure oxygen level is at least 19.5% prior to re-entry.

7. STORAGE AND HANDLING

STORAGE PRECAUTIONS: Store and use with adequate ventilation, outside or detached storage is preferred. Temperature should not exceed 52°C or 125.6°F. Containers are equipped with a pressure relief device and a pressure-controlling valve. Under normal conditions these containers may periodically vent product to control internal pressure. Use adequate pressure relief devices in systems and piping to prevent pressure buildup as trapped liquid can generate extremely high pressures.

Liquid Nitrogen is stored in insulated vessels. Storage vessels must meet applicable governmental standards. Use vessels in accordance with equipment manufacturer's operating instructions. Do not attempt to repair, adjust or in any other way modify the operation of these vessels.

HANDLING PRECAUTIONS: 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. Avoid inhalation of vapours when venting the gas. Always stay upstream of the venting and stay out of low lying areas where gas pockets could accumulate. Avoid any contact of unprotected parts of the body with un-insulated pipes or vessels containing cryogenic fluids. Flesh will stick to the extremely cold metal and may tear when you try to pull free. When mixing nitrogen with one or more gases or liquefied gases, additional unexpected hazards can be created.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

THRESHOLD LIMIT VALUES:

Not applicable because the limiting factor is the available oxygen.

MAINTAIN OXYGEN LEVELS ABOVE 19.5%.

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Signs of asphyxia may be evident when liquid nitrogen gas displaces the oxygen in the air to 15% or less. Prolonged asphyxia leading to death may occur when the oxygen concentration is reduced to 6% or less.

Compressed gases may create low temperatures when they expand rapidly. Leaks and uses that allow rapid expansion may cause a frostbite hazard. Wear appropriate personal protective clothing to prevent the skin from becoming frozen.

Wear appropriate eye protection to prevent eye contact with Nitrogen (which may result in burns or tissue damage from frostbite).

Quick drench facilities and/or eyewash fountains should be provided within the immediate work area for emergency use where there is any possibility of exposure to liquids or gases that are extremely cold or rapidly evaporating.

RESPIRATOR RECOMMENDATIONS:

EMERGENCY OR PLANNED ENTRY INTO UNKNOWN CONCENTRATIONS OR WHERE OXYGEN CONCENTRATION IS BELOW 19.5%: Self-contained breathing apparatus that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode; or supplied-air respirator that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

ESCAPE CONDITIONS: Self-contained breathing apparatus that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode; or supplied-air respirator that has a full face-piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST – Preferred. Use local exhaust to control air contaminants to at or below acceptable exposure guidelines and maintain atmospheric oxygen at 19.5%.

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

SPECIAL – Not applicable.

OTHER – Not applicable.

EYE/FACE PROTECTION: OSHA approved safety glasses and full face shields are required to be utilized at all times when working with or around this product.

SKIN PROTECTION: Protective gloves of any material appropriate for the job. Insulated gloves are recommended for cryogenic liquids.

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RESPIRATORY PROTECTION: Use air supplied respirators where local or general exhaust ventilation is inadequate. OSHA 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 footwear and coveralls/other suitable protective clothing and equipment are to be utilized in accordance with the hazards of the task and site.

9. PHYSICAL AND CHEMICAL PROPERTIES

COLOUR: Nitrogen refrigerated liquid is colourless; vapour is colourless or whitish.

ODOUR: Odourless.

TASTE: Tasteless.

pH: Not Applicable.

MELTING POINT: -210.01°C (-346°F)

FREEZING POINT: -210°C (-346°F)

BOILING POINT: -195.79°C (-320.4°F)

FLASHPOINT: Not Applicable.

EVAPORATION RATE (nBuAc=1): High.

CONDITIONS OF FLAMMABILITY: Non-flammable.

UPPER / LOWER FLAMMABILITY / EXPLOSIVE LIMITS: Not Applicable.

VAPOUR PRESSURE: 1 atm @ 77.347 deg K.

VAPOUR DENSITY: Vapour density at normal temperature is approximately the same as air. Cold gas (as it comes from liquid) is heavier than air.

DENSITY SPECIFIC GRAVITY: 1.251 g/L at 0°C (32°F) and 1 atmosphere; 0.96737 (air = 1); 0.804 (liquid), and 1.0265 (solid).

SOLUBILITIES: 100 volumes water absorbs 2.4 volumes nitrogen at 0°C (32°F); 100 volumes water absorbs 1.6 volumes nitrogen at 20°C (68°F). Soluble in liquid ammonia; 1 volume dissolves 0.1124 volume nitrogen at 20°C (68°F); 2.33 cu m soluble in 100 cc water at 0°C (32°F); 1.42 cu m soluble in 100 cc water at 40°C (104°F).

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COEFFICIENT WATER/OIL DISTRIBUTION: Not Available.

AUTOIGNITION TEMPERATURE: Not Applicable.

DECOMPOSITION: Not Applicable.

MOLECULAR WEIGHT: 28.013

VISCOSITY: 156.3 micropoises @ -21.5 °C (-6.7 °F); 170.7 micropoises @ 10.9 °C (51.62 °F); 178.1 micropoises @ 27.4 °C (81.32 °F); 219.1 micropoises @ 127.2 °C (260.96 °F); 255.9 micropoises @ 226.7 °C (440.06 °F); 279.7 micropoises @ 299 °C (570.2 °F); 337.4 micropoises @ 490 °C (914 °F); 419.2 micropoises @ 825 °C (1517 °F)

GENERAL EXPLOSION SENSITIVITY: Containers may explode when heated. Liquid nitrogen is inherently safer than liquid oxygen or liquid air as a coolant, however its ability to condense liquid oxygen out of the atmosphere can create hazards.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Avoid impact against container.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: N/A

ELECTRICAL CLASSIFICATION: Non-hazardous.

10. STABILITY AND REACTIVITY

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.

POSSIBILITY OF HAZARDOUS REACTIONS: 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. Combines with oxygen & hydrogen on sparking, forming nitric oxide & ammonia; combines directly with lithium, & @ a red heat with calcium, strontium, & barium to form nitrides; forms cyanides when heated with carbon in presence of alkalis or barium oxide.

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INCOMPATIBLE MATERIALS: May react vigorously with lithium, titanium, neodymium, zirconium, and many other reactive metals.

HAZARDOUS DECOMPOSITION PRODUCTS: None known.

11. TOXICOLOGICAL INFORMATION

WARNING! Vapours may cause dizziness or asphyxiation without warning.

Unconsciousness leading to death can occur when the atmospheric oxygen concentration is reduced to 6% to 8% or less. Signs of asphyxia are often noted when atmospheric oxygen is displaced such that the oxygen concentration is 15% to 16% or less. At increasing altitudes, the decreasing atmospheric pressure decreases the partial pressure of oxygen, decreasing the molecules of oxygen available in stipulated percentages.

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:

INHALATION: As Nitrogen is an asphyxiant, high concentrations of vapours 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: Contact with liquid nitrogen or vapours may cause severe frostbite, dermatitis (red, cracked irritated skin), ulceration of the skin (which may be delayed in appearance for several hours), blistering and pain.

INGESTION: An unlikely route of exposure as this product is a gas at normal pressure and temperature. Exposure may result in severe frostbite of the lips and mouth.

EYE CONTACT: Contact with liquid nitrogen or vapours may cause pain, redness, severe cryogenic burns and blindness.

EFFECTS OF ACUTE EXPOSURE TO PRODUCT: Inhalation of liquid nitrogen or vapours may lead to asphyxiation and cause injury to the pharynx. Nitrogen vapours may displace oxygen from the air and cause asphyxia with CNS injury or death if the exposure is sufficiently prolonged. Symptoms of oxygen deficiency include respiratory difficulty, headache, dizziness and nausea. The skin of a victim of over-exposure may have a blue colour. Cardiac arrest, gas embolism, neuropathies, syncope and a variety of dermal injuries may occur following topical application. The effects of frostbite include a change in the skin colour to gray or white, possibly followed by blistering.

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EFFECTS OF CHRONIC EXPOSURE TO PRODUCT: No harm expected to healthy individuals. Where competent medical authority deems that such illness would be aggravated by exposure to nitrogen, persons in ill health should be restricted from working with or handling this product.

OTHER EFFECTS OF OVEREXPOSURE: Not available.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known.

LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: Not available.

TERATOGENICITY: Not listed as a teratogen.

CARCINOGENICITY: Not listed as a carcinogen.

MUTAGENICITY: Not listed as a mutagen.

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: None.

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: Necessary measures should be taken to prevent waste from contaminating the surrounding environment while ensuring personnel are out of harm's way. Any product, residue, disposable container, or liner should be discarded of in an environmentally safe manner; and must be in full compliance with all applicable federal, state/provincial, and other applicable local regulations.

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14. TRANSPORT 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 (2008) NUMBER:	120

SPECIAL TRANSPORT INFORMATION: Bulk shipments are transported in pressurized vessels which must meet applicable local regulations and be operated in accordance with manufacturer's operating instructions. 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.

OTHER TRANSPORT INFORMATION: Drivers must be aware of load characteristics and through the completion of required Hazmat/TDG training must know what to do in the event of an accident or emergency. All shipments must be transported in accordance with applicable regulations.

15. REGULATORY INFORMATION

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.

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 SDS contains all the information required by the CPR.

16. PREPARATION INFORMATION

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PREPARATION DATE:

10/17/2012

REVISION DATE:

N/A

EXPIRY DATE:

10/17/2015

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