



Aceti-Oxígeno, S.A.

FABRICANTES DE GASES PARA USO MÉDICO, ALIMENTICIO E INDUSTRIALES

MATERIAL SAFETY DATA SHEET

(MSDS MATERIAL SAFETY DATA SHEET)

Annex 13

LIQUID NITROGEN

1. Product and company identification

- | | | |
|------|-----------------------|--|
| 1.1 | Product name: | Cryogenic Liquid Nitrogen |
| 1.2 | Common chemical name: | Nitrogen |
| 1.3 | IUPAC chemical name: | Nitrogen |
| 1.4 | Chemical family: | Family of inert gases |
| 1.5 | Condensed formula: | N ₂ |
| 1.6 | Synonyms: | Nitrogen, Nitrogen NF, Liquid Nitrogen |
| 1.7 | Company name: | Aceti-Oxígeno, S.A. |
| 1.8 | Company address: | Panama Mañanitas-Industrial Zone |
| 1.9 | Telephone: | Tel. 321-8888 |
| 1.10 | Emergency Telephone: | 103 Fire Brigade |
| 1.11 | REVISION DATE: | June 20. of 2022, rev. 1, valid until: June 20, 2027 |
| 1.12 | Use: | In inertization, pressurization, protection, cryogenic storage, cryosurgery and conservation of substances susceptible to oxidation. |

2. Composition or information on ingredients

- | | | |
|-----|-------------------------------|-------------------|
| 2.1 | Ingredient name: | Nitrogen |
| 2.2 | CAS ^[1] Number: | 7727-37-9 |
| 2.3 | Percentage: | > 99% |
| 2.4 | OSHA PEL-TWA ^[2] : | None |
| 2.5 | ACGIH TLV ^[3] : | Simple asphyxiant |
| 2.6 | [LD ₅₀]: | None |
| 2.7 | [LC ₅₀]: | None |

[1] Chemical Abstracts Service (International Material Identification Number according to the Chemical Abstracts Service)

[2] Occupational Safety and Health Administration. Permissible Exposure Limits. Time Weighted Average (Occupational Safety and Hygiene Administration. Permissible Exposure Limits. Time weighted average exposure)

[3] American Conference of Governmental Industrial Hygienists. Threshold Limit Value (North American Conference of Governmental Industrial Public Health. Threshold Limit Value)

3. Risk identification

- | | |
|-------|---|
| 3.1 | Considerations and hazards during emergencies |
| 3.1.1 | Extremely cold liquid and gas under pressure |
| 3.1.2 | Can quickly cause suffocation |
| 3.1.3 | May cause severe instantaneous freezing injury (cryogenic injury) |
| 3.2 | Information on potential health effects |
| 3.2.1 | Exposure routes |

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Panama, July 28, 2022.

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- 3.2.1.1 Inhalation: Simple asphyxiant. Nitrogen is not toxic, but it can cause suffocation by displacing oxygen from the air. Exposure to atmospheres deficient in oxygen (less than 19.5%) can cause dizziness, drowsiness, nausea, vomiting, excessive salivation, decreased alertness, loss of consciousness, and death. Exposure to atmospheres containing 8% to 10% or less oxygen will cause unconsciousness without warning and so rapidly that individuals are unable to help or protect themselves. Severe oxygen deficiency can cause serious damage and even death.
- 3.2.1.2 Contact with eyes: Tissue frostbite and severe cryogenic burns of the eye
- 3.2.1.3 Skin contact: Tissue frostbite and severe cryogenic skin burns
- 3.2.1.4 Absorption through the skin: Not applicable
- 3.2.1.5 Ingestion: Does not apply because cryogenic injury to the mouth and oral mucosa occurs first
- 3.2.2 Chronic effects: No chronic effects have been established from its use.
- 3.2.3 Medical conditions aggravated by overexposure: None
- 3.2.4 Other effects of overexposure: None
- 3.2.5 Carcinogenicity: Liquid Nitrogen is not listed by NTP^[4], OSHA or IARC^[5]

^[4] National Toxicology Program

^[5] International Agency for Research on Cancer

4. First aid

- 4.1 Inhalation: Move person to fresh air. If there is no breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Get immediate medical attention.
- 4.2 Contact with the eyes: In case of splashes in the eyes, wash them immediately with water for at least 15 minutes. Seek medical attention immediately, preferably from a specialised ophthalmologist.
- 4.3 Skin contact: Remove any clothing that impedes blood circulation to the frostbitten area. Do not rub frostbitten areas because this can further damage the integrity of the affected tissue. As soon as possible, place the affected area under a lukewarm bath not to exceed 105°F (40°C). Never use the dry heat produced by an electric dryer. In case of massive exposure, remove clothing only while providing a lukewarm shower. Call a doctor as soon as possible.

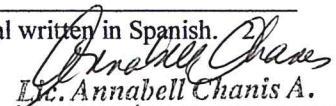
Frozen tissue is painless and has a waxy appearance with a yellowish tint. In a short time, as it thaws, inflammation, pain and a tendency to infection will occur. If the body region has thawed before medical attention occurs, cover the area with dry sterile gauze and a protective drape. Some doctors recommend the friction-free application of glycerol or glycerine to the affected area before applying sterile gauze.
- 4.4 Ingestion: Not applicable because cryogenic injury to the mouth and oral mucosa occurs first.
- 4.5 Remarks to the doctor: None

5. Measures in case of fire

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- 5.1 Ignition point: Not applicable.
- 5.2 Auto ignition: Non-flammable
- 5.3 Flammable limits in air, volume by volume:
 - 5.3.1 Lower: Not applicable
 - 5.3.2 Superior: Not applicable
- 5.4 Extinguishing media: Nitrogen is non-flammable and does not stimulate combustion. Use appropriate extinguishing media for the surrounding flammable materials.
- 5.5 Special instructions to firefighters: Nitrogen is a simple asphyxiant. If possible, remove liquid nitrogen cylinders from the fire area and cool them with water, applying it to the cylinder body and not to the

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vent systems to prevent the formation of ice that obstructs the release of excess gas pressure from the container. Rescue workers may require self-contained breathing equipment. Evacuate the area.

5.6 Unusual fire and explosion hazards: Spilled liquid nitrogen and its consequent rapid vaporization will form an oxygen deficient vapor cloud. Evacuate the area where the vapor cloud is located, since visibility is reduced. Pressure in a container can rise due to heat, which can cause it to rupture if pressure relief devices fail to function.

5.7 Hazardous combustion products: None known.

5.8 Sensitivity to static discharge: None

5.9 Sensitivity to mechanical impact: None

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6. Measures in case of accidental release

6.1 Steps to be taken if material is released or spilled:

6.1.1 Evacuate all personnel from the affected area

6.1.2 Disconnect the nitrogen source if there is no additional risk in doing so.

6.1.3 Ventilate the area or move cylinders outside the facility.

6.1.4 If a leak is observed from the cylinder body or its valve, immediately contact Aceti-Oxígeno, S.A.

7. Handling and storage

7.1 Storage precautions

7.1.1 Store and use with adequate ventilation. Do not store in a confined space.

7.1.2 Cylinders must be stored upright with the valve protection cap in place, properly secured to prevent them from falling or being hit.

7.1.3 Cryogenic containers are equipped with pressure relief devices to control their internal pressure. Under normal conditions it is usual for these containers to pour out some product

7.1.4 Some metals such as carbon steel can become brittle at low temperatures and fracture easily.

7.1.5 Avoid entrapment of liquid nitrogen in closed piping or systems that lack pressure relief devices.

7.1.6 Protect cylinders from any physical damage. Do not drag, roll, slide or drop them.

7.1.7 Do not allow storage temperature to exceed 125°F (52°C).

7.1.8 Full and empty cylinders must be separated.

7.1.9 Use a FIFO (first-in, first-out) inventory system to prevent full cylinders from being stored for long periods of time.

7.2 Precautions to be taken in handling

7.2.1 Never allow any unprotected part of the human body to come into contact with uninsulated pipes or tanks containing or dispensing cryogenic liquids as the extremely cold metal will cause immediate skin sticking and tearing upon removal.

7.2.2 Use a four-wheel cart for cylinder movement.

7.2.3 Containers must be used and stored in a vertical position.

7.2.4 Do not drop or roll cryogenic liquid containers on their side.

7.2.5 If there is any difficulty in the operation of the valve, discontinue its use and contact Aceti-Oxígeno, S.A.

7.2.6 Never insert an object (a tool such as a wrench, a screwdriver, etc.) into the openings of the valve protection cap, as it may be damaged and cause nitrogen leakage.

7.2.7 Never bring an electric arc near a compressed gas cylinder or make it part of an electrical circuit.

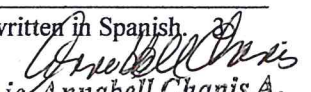
7.2.8 For additional precautions in the use of nitrogen, see Section 16. Other Information.

8. Exposure control and personal protection

8.1 Infrastructure controls

8.1.1 Ventilation: Provide adequate natural ventilation or mechanical ventilation to prevent the appearance of oxygen-deficient atmospheres that contain less than 19.5% oxygen.

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- 8.2 Respiratory protection
- 8.2.1 General routine use: Not required
- 8.2.2 Emergency use: Self-contained breathing apparatus or positive pressure airline with face mask is required for use in oxygen-deficient atmospheres. Air-purifying respirator systems will not provide any protection.
- 8.3 Protective gloves: It is recommended to wear loose thermal insulating gloves, or leather gloves when handling cylinders of cryogenic liquids.
- 8.4 Protection of eyes: The use of full-face shields and safety glasses is recommended for handling cryogenic liquid cylinders.
- 8.5 Other protective equipment: The use of safety footwear is recommended for handling cylinders. It is convenient to wear long-sleeved shirts and pants without outside cuffs.

9. Physical and chemical properties

- 9.1 Molecular weight: 28.0134 g/mol
- 9.2 Boiling point (1 atmosphere): -320.4°F (-195.8°C)
- 9.3 Specific gravity (Air = 1) at 70°F (21.1°C) and 1 atmospheric pressure: 0.967
- 9.4 Melting point (1 atmosphere): -345.8°F (-209.9°C)
- 9.5 Vapor pressure at 70°F (21.1°C): Not applicable
- 9.6 Gas density at 70°F (21.1°C) and 1 atmospheric pressure: 0.072 lb/cf or 1,153 Kg/m³
- 9.7 Evaporation rate (Butyl Acetate = 1): Not applicable because it is a gas.
- 9.8 Solubility in water:
- 9.8.1 Vol/Vol at 32°F (0°C) and 1 atmospheric pressure: 0.023
- 9.9 Expansion ratio: Not applicable
- 9.10 pH: Not applicable
- 9.11 Appearance, odor and condition: Colorless and odorless cryogenic liquid.
- 9.12 Water/oil distribution coefficient: Not available
- 9.13 Odor threshold: Not applicable

10. Stability and reactivity

- 10.1 Stability: Stable
- 10.2 Conditions to avoid: None
- 10.3 Incompatibilities (Materials to avoid): None
- 10.4 Reactivity:
- 10.4.1 Hazardous decomposition products: None
- 10.4.2 Hazardous polymerization products: Will not occur.

11. Toxicological information

- 11.1 General toxicological effect: Simple asphyxiant
- 11.2 Ability to cause irritation: None
- 11.3 Sensitization to material: None
- 11.4 Effects on the reproductive system: None

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- 11.5 Teratogenicity: None
- 11.6 Mutagenicity: None
- 11.7 Synergistic Materials: None

12. Ecological information

No adverse or negative ecological impacts are expected because the atmosphere contains approximately 78% nitrogen. Liquid Nitrogen contains no Class I or Class II chemicals, which deplete the ozone layer (40 CFR [6] Part 82). Liquid Nitrogen is not listed as a marine pollutant by DOT [7] (49 CFR Part 171).

[6] Code of Federal Regulations (United States Code of Federal Regulations)

[7] Department of Transportation of the United States of America

13. Disposal considerations

- 13.1 Waste disposal method: Do not attempt to dispose of residual or unused amounts. Return the cylinder to the supplier.
- 13.2 For emergency disposal, secure cylinder and slowly discharge gas to atmosphere in a well-ventilated area or outdoors.

14. Transport information

- 14.1 DOT/IMO shipping name: Nitrogen, refrigerated liquid.
- 14.2 Hazard Classification: 2.2 (Non-flammable gas)
- 14.3 Identification number: UN 1977
- 14.4 Product identification number: 1977
- 14.5 Product reportable quantity: Not applicable
- 14.6 Shipping labels: Non-flammable Gas
- 14.7 Placard: Non-flammable Gas
- 14.8 Special shipping information: Cylinders must be transported in a secure upright position, in a well-ventilated vehicle. The transport of compressed gases in automobiles or closed body vehicles can present great safety risks and should not be recommended or encouraged. For air shipments, the handling label called "Cryogenic Liquid" must be used in addition to the risk label of non-flammable gas (Division 2.2) to the packaging or structures associated with the transport containers of cryogenic liquids

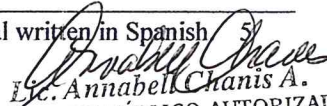
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15. Related Regulations

The following information is related to United States regulatory requirements potentially applicable to this product in Panama. Users of this product are responsible for complying with their local or general regulatory requirements.

- 15.1 United States Federal Regulations
 - 15.1.1 EPA - Environmental Protection Agency
 - 15.1.1.1 CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (40 CFR Parts 117 and 302). Reportable Quantity RQ: Not applicable
 - 15.1.1.2 SARA: Superfund Amendment and Reauthorization Act
 - Section 302/304: Requires emergency planning based on Threshold Planning Quantities (TPQ) and release reporting based on Reportable Quantities (RQ) of EPA-scheduled substances as extremely hazardous (40 CFR Part 355)

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Extremely Hazardous Substance: Not Applicable

Planning Threshold Quantity: Not applicable

Section 311/312: Requires the submission of a Material Safety Data Sheet (MSDS) and a chemical inventory report with identification of the risk classes defined by the EPA (40 CFR Part 370). The hazard classes for this product are:

Immediate: Yes
Late: No
Pressure: Yes
Reactivity: No
Fire: No

Section 313: Requires submission of annual toxic chemical release reports listed in 40 CFR Part 372. Liquid Nitrogen is not required to report under this Section.

- 15.1.2 40 CFR Part 68: Risk Management for Chemical Accidental Release: Requires the development and implementation of risk management programs in manufacturing facilities, use, storage, or any other Controlled substance handled in amounts exceeding specified thresholds. Nitrogen is not listed as a regulated substance.
- 15.1.3 TSCA Toxic Substance Control Act: Nitrogen is listed on the inventory of controlled products by TSCA.
- 15.2 OSHA Occupational Safety and Health Administration
- 15.2.1 29 CFR 1910.119: Process Safety Management of Highly Hazardous Chemicals: Requires facilities to develop Process Safety Management based on Threshold Quantities (TQ) of products high-risk chemicals, such as those listed in Appendix A. Liquid Nitrogen is not listed in Appendix A as a high-risk chemical.
- 15.3 FDA - Food and Drug Administration
- 15.3.1 21 CFR 184.1540: Recognized as a safe supply and ingredient (GRAS) in food for human consumption when used as a pressurizer, propellant, in modified atmosphere packaging and others. Nitrogen NF (National Formulary) is regulated by the FDA as a prescription drug.

16. Additional information

- 16.1 Special precautions: Use piping and equipment properly designed to withstand working pressures. Use a check valve or other cylinder protection device to prevent and avoid reverse flow. To prevent cryogenic liquids or cold gases from becoming trapped in distribution piping, they should be equipped with pressure relief devices. Only those pipes or transfer lines properly designed for cryogenic liquids should be used. It is recommended that all vents or emissions from liquid nitrogen vaporization be piped to the outside of the facility.

Shipping compressed gas cylinders that have been filled without the consent of the cylinder owner is a violation of US federal law [49CFR Part 173.301(b)].

16.2 Other data:

16.2.1 NFPA Valuation (National Fire Protection Association)

Health 3
Flammability 0
Instability 0

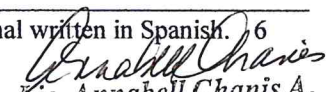
Special Simple Asphyxiant (CGA recommended designation)

16.2.2 HMIS Valuation (Hazardous Materials Identification Systems)

Health 3
Flammability 0

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Reactivity 0

Classification of the chemical substance according to the SGA:

Physical hazards: Gases under pressure, Refrigerated liquefied gas

Health Hazards: N/A.

Environmental Hazards: N/A.

Elements for the communication and signalization of hazards:

Word of warning: Attention.

Hazard statements:

H281: Contains refrigerated gas; may cause cryogenic burns or injuries.

Precautionary advice:

Prevention:

P282: Wear cold-insulating gloves and eye/face protection.

Response:

P315: Seek immediate medical assistance

P336: Thaw frozen parts with lukewarm water. Do not rub the affected part.

Storage:

P403: Store in a well-ventilated place.

Elimination: N/A.

Other dangers:

It can act as a simple asphyxiant, diluting the concentration of oxygen in the air to levels below those necessary to support life. The inhalation of nitrogen in excessive concentrations can cause: dizziness, vomiting, loss of consciousness and death.

Containers may explode when heated.

Ruptured cylinders can be projected.

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Pictogram/ Hazard Symbol:



16.3 Standard valve connection for the United States and Canada

16.3.1 Coiled: Standard CGA 295. In Panama the standard is CGA 295.

Use the proper CGA connection. DO NOT USE ADAPTERS.

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More detailed information on Liquid Nitrogen can be found in the following documents published by the Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Phone (703) 412-0900:

- G-10.1 Commodity Specifications for Nitrogen
- P-9 Inert Gases - Argon, Nitrogen, Helium
- P-12 Safe Handling of Cryogenic Liquids
- P-14 Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmospheres
- SB-2 Oxygen Deficient Atmospheres
- AV-1 Safe Handling and Storage of Compressed Gases
- AV-5 Safe Handling of Liquefied Nitrogen and Argon

Conversion Table

NITROGEN (N₂) 28.013 g/mol PE=-195.8 °C						
UNITS	WEIGHT		GAS VOLUME		LIQUID VOLUME	
	Pounds	Kilograms	SCF Gas	Nm ³ Gas	Liquid gallons	Liquid liters
Pounds	1.000	0.454	13.803	0.363	0.148	0.561
Kilograms	2.205	1.000	30.420	0.800	0.326	1.235
SCF Gas	0.072	0.033	1.000	0.026	0.011	0.041
Nm ³ Gas	2.757	1.251	38.040	1.000	0.408	1.544
Liquid gallons	6.745	3.060	93.110	2.447	1.000	3.785
Liquid liters	1.782	0.808	24.600	0.646	0.264	1.000

COMPATIBILITY WITH OTHER MATERIALS

Metals

Bronze	Satisfactory
303 Stainless Steel	Satisfactory (same as 304L and 304LN)
316 Stainless Steel	Satisfactory (same as 316L, 321 and 347)
Aluminum	Satisfactory (same as alloys with Copper, Manganese, Manganese-Silicon and Zinc)
Zinc	Unsatisfactory
Copper	Satisfactory
Monel-metal	Satisfactory

Plastics

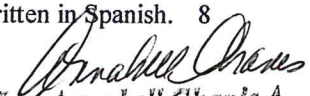
PCTFE	Unsatisfactory
Teflon	Satisfactory
Tefzel	No information available
Kynar	No information available
PVC	Unsatisfactory
Polycarbonate	Unsatisfactory

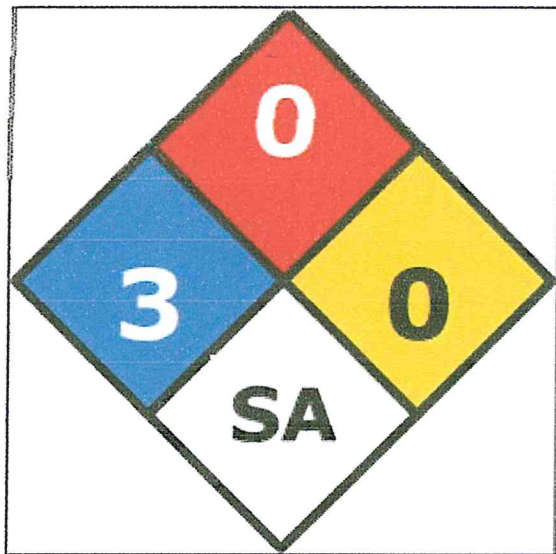
Elastomers

Kalrez	Unsatisfactory
Viton	Unsatisfactory
Buna-N	Unsatisfactory
Neoprene	Unsatisfactory
Polyurethane	Unsatisfactory

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Change control:

Revision 01:

- Added safety color code for NFPA and the global harmonized system.
- The format was modified to the standards and approved by the sister companies Infra and Productos del Aire.

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