



NITRIC OXIDE

Safety Data Sheet

1. IDENTIFICATION

Product identifier

Product Name NITRIC OXIDE

Other means of identification

Safety data sheet number LIND-P085

UN / ID no. UN1660

Synonyms Mononitrogen Monoxide; Nitrogen Monoxide

Recommended use of the chemical and restrictions on use

Recommended Use Industrial and professional use.

Uses advised against Consumer use

Details of the supplier of the safety data sheet

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.

Road 869, Km 1.8

Barrio Palmas, Catano, PR 00962

Phone: 787-641-7445

www.pr.lindegas.com

Linde Canada Limited

5860 Chedworth Way

Mississauga, Ontario L5R 0A2

Phone: 905-501-1700

www.lindecana.com

* May include subsidiaries or affiliate companies / divisions.

For additional product information contact your local customer service.

Emergency telephone number

Company Phone Number 905-501-0802 (Canada) 800-232-4726 (Linde National Operations Center, US)

CHEMTREC: 1-800-424-9300 (North America) +1-703-527-3887 (International)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Acute toxicity - Inhalation (Gases)	Category 1
Skin corrosion / irritation	Category 1 Sub-category B
Serious eye damage / eye irritation	Category 1
Oxidizing gases	Category 1
Gases under pressure	Compressed gas

Label elements

Signal word

Danger

Hazard Statements

May cause or intensify fire; oxidizer

Contains gas under pressure; may explode if heated

Fatal if inhaled

Causes severe skin burns and eye damage

May cause damage to lungs

Symptoms may be delayed

Precautionary Statements - Prevention

Do not handle until all safety precautions have been read and understood

Keep and store away from clothing and other combustible materials

Keep valves and fittings free from oil and grease

Do not breathe gas.

Do not get in eyes, on skin, or on clothing

Use and store only outdoors or in a well ventilated place

Wear protective gloves, protective clothing, eye protection, respiratory protection, and / or face protection

Use a backflow preventive device in piping

Use only equipment of compatible materials of construction and rated for cylinder pressure

Use only with equipment cleaned for oxygen service

Do not open valve until connected to equipment prepared for use

Open valve slowly

Close valve after each use and when empty

When returning cylinder, install leak tight valve outlet cap or plug

Precautionary Statements - Response

IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor / physician.

IF ON SKIN (or hair): Remove / Take off immediately all contaminated clothing. Rinse skin with water / shower.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

Get medical attention / advice

In case of fire: Stop leak if safe to do so

Precautionary Statements - Storage

Store locked up
Protect from sunlight when ambient temperature exceeds 52°C / 125°F

Precautionary Statements - Disposal
Dispose of contents / containers in accordance with container supplier / owner instructions

Hazards not otherwise classified (HNOC)
Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Volume %	Chemical Formula
Nitric oxide	10102-43-9	100	NO

4. FIRST AID MEASURES

Description of first aid measures

General advice	Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.
Inhalation	Remove to fresh air and keep comfortable for breathing. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration. Get medical attention immediately. Any physical exertion during this period should be discouraged as it may increase the severity of the pulmonary edema or chemical pneumonitis. Bed rest is indicated.
Skin contact	Wash off immediately with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Immediate medical attention is required.
Eye contact	Immediately flush eyes with running water for at least 30 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Keep eye wide open while rinsing. Do not rub affected area. Immediate medical attention is required.
Ingestion	Not an expected route of exposure.
Self-protection of the first aider	RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Use personal protective equipment. Avoid contact with skin, eyes and clothing. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Most important symptoms and effects, both acute and delayed

Symptoms	Inhalation of corrosive fumes / gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. May cause burns of eyes, skin and mucous membranes. Symptoms may be delayed.
----------	---

Indication of any immediate medical attention and special treatment needed

Note to physicians	Treat symptomatically.
--------------------	------------------------

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Specific extinguishing methods

Continue to cool fire exposed cylinders until flames are extinguished. Damaged cylinders should be handled only by specialists.

Specific hazards arising from the chemical

Non-flammable gas. May cause or intensify fire; oxidizer. Will support and accelerate combustion of combustible materials (wood, paper, oil, debris, etc). Nitric oxide hydrolyzes to nitric acid in the presence of moisture. The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating and toxic gases and vapors. Cylinders may rupture under extreme heat.

Hazardous combustion products Nitric acid and nitrous acid.

Protective equipment and precautions for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA / NIOSH (approved or equivalent) and full protective gear. Corrosive hazard. Wear chemically protective gloves / clothing and eye / face protection. Additional chemical protective clothing may be required to protect from toxic decomposition products.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions Evacuate personnel to safe areas. Keep people away from and upwind of spill / leak. Ensure adequate ventilation, especially in confined areas. Monitor concentration of released product. Eliminate all ignition sources if safe to do so. Use personal protection recommended in Section 8. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.

Environmental precautions

Environmental precautions Prevent spreading of vapors through sewers, ventilation systems and confined areas.

Methods and material for containment and cleaning up

Methods for containment 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.

Methods for cleaning up Return cylinder to Linde or an authorized distributor.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling Nitric oxide is non-corrosive and may be used with most common structural materials. However, in the presence of moisture and oxygen, corrosive conditions will develop as a result of the formation of nitric and nitrous acids. Prior to use, systems to contain nitric oxide must first be purged with an inert gas. Where air contamination cannot be eliminated stainless steel should be used. Use only equipment of compatible materials of construction. Use only with equipment cleaned for oxygen service. Keep valves and fittings free from oil and grease. Open valve slowly. "NO SMOKING" signs should be posted in storage and use areas. Separate flammable gas cylinders from oxygen and other oxidizers by a minimum distance of 20 ft. or by a 5 ft. high barrier with a minimum fire resistance rating of a half an hour.

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. Never attempt to lift a cylinder by its valve protection cap. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Use only with adequate ventilation. Use a backflow preventive device in piping. Use only with equipment rated for cylinder pressure. Close valve after each use and when empty. If user experiences any difficulty operating cylinder valve discontinue use and

contact supplier. Ensure the complete gas system has been checked for leaks before use.

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.

Only experienced and properly instructed persons should handle gases under pressure. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

Conditions for safe storage, including any incompatibilities

Storage Conditions	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. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Full and empty cylinders should be segregated. Do not store near combustible materials. Stored containers should be periodically checked for general condition and leakage.
Incompatible materials	Strong oxidizing agents. Hydrocarbons. Halides. Boron. Phosphorus trihydride (phosphine). chromium. Uranium. Combustible material. Organic material.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Nitric oxide 10102-43-9	TWA: 25 ppm	TWA: 25 ppm TWA: 30 mg / m ³	IDLH: 100 ppm TWA: 25 ppm TWA: 30 mg / m ³

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 Information	Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).
-------------------	---

Appropriate engineering controls

Engineering Controls	Showers. Eyewash stations. Ventilation systems. Exhaust gas should be vented to a gas treatment system. Consider installation of leak detection systems in areas of use and storage. Systems under pressure should be regularly checked for leakages.
----------------------	---

Individual protection measures, such as personal protective equipment

Eye / face protection	Tightly fitting safety goggles. Face protection shield.
Skin and body protection	Work gloves and safety shoes are recommended when handling cylinders. Gloves must be clean and free from grease or oil. 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	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.
General Hygiene Considerations	Handle in accordance with good industrial hygiene and safety practice. Do not get in eyes, on skin, or on clothing. Do not eat, drink or smoke when using this product. Wash hands before breaks and immediately after handling the product. Remove and wash contaminated clothing before re-use.

Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Compressed gas
Appearance	Reddish-brown in air.
Odor	Acrid.
Odor threshold	0.29-0.97 ppm
pH	No data available
Melting point	-163.6 °C / -262.5 °F
Evaporation rate	Not applicable
Fire Hazard	Yes
Lower flammability limit:	Not applicable
Upper flammability limit:	Not applicable
Flash point	Not applicable
Autoignition temperature	No data available
Decomposition temperature	No data available
Oxidizing properties	Oxidizer
Water solubility	7.4 (vol/vol @ 0°C and 1 atm)
Partition coefficient	No data available
Kinematic viscosity	Not applicable

Chemical Name	Molecular weight	Boiling point	Vapor Pressure	Vapor density (air =1)	Gas Density kg/m ³ @20°C	Critical Temperature
Nitric oxide	31.01	-151.8 °C	Above critical temperature	1.04	1.248	-92.9 °C

10. STABILITY AND REACTIVITY

Reactivity

No data available

Chemical stability

Stable under recommended storage and handling conditions (see Section 7).

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	None.

Possibility of Hazardous Reactions

None under normal processing.

Conditions to avoid

Heat, flames and sparks. Reacts vigorously with fluorine, fluorine oxides, and chlorine in the presence of moisture.

Incompatible materials

Strong oxidizing agents. Hydrocarbons. Halides. Boron. Phosphorus trihydride (phosphine). chromium. Uranium. Combustible material. Organic material.

Hazardous Decomposition Products

Oxidizes in air to form nitrogen dioxide, which is extremely reactive and a strong oxidizer. Upon contact with moisture and oxygen, produces nitrous and nitric acid.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	Mice which inhaled a total of 320 ppm nitric oxide exhibited convulsions or effects on seizure threshold as well as cyanosis. Corrosive to respiratory system.
Skin contact	Corrosive. Causes severe irritation and or burns.
Eye contact	Corrosive to the eyes and may cause severe damage including blindness.
Ingestion	Not an expected route of exposure.

Information on toxicological effects

Symptoms	May be fatal if inhaled. Inhalation of corrosive fumes / gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Symptoms may be delayed.
----------	--

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion / irritation	Category 1B.
Serious eye damage / eye irritation	Category 1.
Irritation	Causes severe irritation and or burns.
Corrosivity	Corrosive to living tissue.
Sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	This product does not contain any carcinogens or potential carcinogens listed by OSHA, IARC or NTP.
Reproductive toxicity	Not classified.
STOT - single exposure	Not classified.
STOT - repeated exposure	Not classified.
Chronic toxicity	Repeated exposure to nitric oxide may cause a permanent decrease in pulmonary function (Silo Filler's Disease) or chronic irritation of the respiratory tract, tooth corrosion and gradual loss of strength.
Target Organ Effects	Respiratory system, Eyes, Skin.
Aspiration hazard	Not applicable.

Numerical measures of toxicity

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50	Inhalation LC50 (CGA P-20)
Nitric oxide 10102-43-9	-	-	115 ppm / 1 hr (Rat) NO ₂	115 ppm / 1 hr (Rat) NO ₂

Product Information

Oral LD50	No information available
Dermal LD50	No information available
Inhalation LC50	No information available

12. ECOLOGICAL INFORMATIONEcotoxicity

No known acute aquatic toxicity.

Persistence and degradability

Not applicable.

Bioaccumulation

No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes 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.

14. TRANSPORT INFORMATION

DOT

UN / ID no.	UN1660
Proper shipping name	Nitric oxide, compressed
Hazard Class	2.3
Subsidiary class	5.1, 8
Special Provisions	1, B77
Description	UN1660, Nitric oxide, compressed, 2.3 (5.1 8)
Additional Description:	"Toxic-Inhalation Hazard Zone A" If net weight of product is greater than or equal to 10 lbs., the shipping description must also contain the letters "RQ".
Additional Marking Requirements:	"Inhalation Hazard" If net weight of product is greater than or equal to 10 lbs., the container must also be marked with the letters "RQ".
Emergency Response Guide Number	124

TDG

UN / ID no.	UN1660
Proper shipping name	Nitric oxide, compressed
Hazard Class	2.3
Subsidiary class	5.1 8
Description	UN1660, Nitric oxide, compressed, 2.3 (5.1 8)

MEX

UN / ID no.	UN1660
Proper shipping name	Nitric oxide, compressed
Hazard Class	2.3
Subsidiary class	5.1 8
Description	UN1660, Nitric oxide, compressed, 2.3 (5.1 8)

IATA

Forbidden

IMDG

UN / ID no.	UN1660
Proper shipping name	Nitric oxide, compressed
Hazard Class	2.3
Subsidiary hazard class	5.1 8
EmS-No.	F-C, S-W
Description	UN1660, Nitric oxide, compressed, 2.3 (5.1 8)

ADR

UN / ID no.	UN1660
Proper shipping name	Nitric oxide, compressed
Hazard Class	2.3 5.1 8
Classification code	1TOC
Tunnel restriction code	(D)
Description	UN1660, Nitric oxide, compressed, 2.3 5.1 8, (D)
Labels	2.3 + 5.1 + 8

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL / NDSL	Complies
EINECS / ELINCS	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL / NDSL - Canadian Domestic Substances List / Non-Domestic Substances List

EINECS / ELINCS - European Inventory of Existing Chemical Substances / European List of Notified Chemical Substances

US 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	Yes
Fire Hazard	Yes
Sudden release of pressure hazard	Yes
Reactive Hazard	No

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302).

Chemical Name	Hazardous Substances RQs	CERCLA / SARA RQ	Reportable Quantity (RQ)
Nitric oxide 10102-43-9	10 lb	10 lb	RQ 10 lb final RQ RQ 4.54 kg final RQ

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.

CWA (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:

Chemical Name	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances	U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
Nitric oxide	10000 lb		250 lb

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
---------------	------------	---------------	--------------

Nitric oxide 10102-43-9	X	X	X
----------------------------	---	---	---

International Regulations

Chemical Name	Carcinogenicity	Exposure Limits
Nitric oxide		Mexico: TWA 25 ppm Mexico: TWA 30 mg / m ³ Mexico: STEL 35 ppm Mexico: STEL 45 mg / m ³

16. OTHER INFORMATION

NFPA Health hazards 4 Flammability 0 Instability 1 Physical and Chemical Properties OX

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.

Issue Date 25-Mar-2015
Revision Date 28-Apr-2015
Revision Note Not applicable

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