

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND THE COMPANY/UNDERTAKING

Identification of the substance/preparation	: Nitric oxide
Chemical formula	: NO
Other means of identification	: Nitric oxide, Mononitrogen Monoxide, Nitrogen Monoxide
Use of the Substance/Mixture	: General Industrial
Restrictions on Use	: No data available.
Manufacturer/Importer/Distributor	: Versum Materials Singapore Pte. Ltd. 2 International Business Park #03-24, The Strategy Singapore 609930 Toll Free No: 800 448 1755
Email Address – Technical Information	: prodinfo@airproducts.com
Telephone	: 800 448 1755
Emergency telephone number (24h)	: 800-101-2201 / +(65)-31581349

2. HAZARDS IDENTIFICATION

GHS classification

Oxidizing gases - Category 1
Gases under pressure - Compressed gas.
Acute toxicity - Inhalation Category 1
Skin corrosion - Category 1B
Serious Eye Damage - Category 1

GHS label elements

Hazard pictograms/symbols



Signal Word: Danger

Hazard Statements:

H270: May cause or intensify fire; oxidiser.

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

H280:Contains gas under pressure; may explode if heated.
H314:Causes severe skin burns and eye damage.
H330:Fatal if inhaled.
EUH071:Corrosive to the respiratory tract.

Precautionary Statements:

Prevention : P244:Keep valves and fittings free from oil and grease.
P260:Do not breathe dust/fume/gas/mist/vapours/spray.
P280:Wear protective gloves/protective clothing/eye protection/face protection
P220:Keep away from clothing and other combustible materials.

Response : P305+P351+P338 :IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P370+P376 :In case of fire: Stop leak if safe to do so.
P304+P340 :IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P303+P361+P353 :IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P315 :Get immediate medical advice/attention.

Storage : P403:Store in a well-ventilated place.
P405:Store locked up.

Other hazards which do not result in classification

Very toxic by inhalation.
High pressure, oxidizing gas.
Vigorously accelerates combustion.
Keep oil, grease, and combustibles away.
May react violently with combustible materials.
Extremely reactive.
May react violently with water.
Do not breathe gas.
Corrosive to eyes, respiratory system and skin.
Wear self-contained breathing apparatus and protective suit.

Environmental Effects

Dangerous for the environment.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance/Mixture : Substance

Components	Chemical formula	CAS Number	Concentration (Volume)
Nitrogen monoxide	NO	10102-43-9	100 %

Concentration is nominal. For the exact product composition, please refer to technical specifications.

4. FIRST AID MEASURES

General advice : Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

if breathing stopped.

- Eye contact : In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Keep eye wide open while rinsing.
- Skin contact : Immediate medical treatment is necessary as untreated wounds from corrosion of the skin heal slowly and badly. Flush with copious amounts of water until treatment is available.
- Ingestion : Ingestion is not considered a potential route of exposure.
- Inhalation : Move to fresh air. In case of shortness of breath, give oxygen. If breathing has stopped or is labored, give assisted respirations. Supplemental oxygen may be indicated. If the heart has stopped, trained personnel should begin cardiopulmonary resuscitation immediately. Mouth to mouth resuscitation is not recommended. If unconscious place in recovery position and seek medical advice. Consult a doctor.

Notes to physician

- Treatment : Absorption of nitric oxide may lead to the formation of methemoglobin, and a conversion fraction of 10% may be noted as a "lilac" cyanosis. High levels of conversion (>35-40%) may be indications for treatment with intravenous methylene blue or exchange transfusion. Nitric oxide and its reaction product nitrogen dioxide are deep lung irritants and produce chemical pneumonitis and pulmonary edema, often delayed in onset. Lung injury caused by inhalation of oxides of nitrogen may be accompanied by bacterial infection of the airway and delayed bronchiolitis obliterans. If nitric oxide and nitrogen dioxide have been inhaled under conditions which produce lung effects, the participation of a physician skilled in the treatment of pulmonary disease is essential. If exposed or concerned: Get medical attention/advice.

5. FIRE-FIGHTING MEASURES

- Suitable extinguishing media : All known extinguishing media can be used.
- Specific hazards : Upon exposure to intense heat or flame, cylinder will vent rapidly and or rupture violently. Oxidant. Strongly supports combustion. May react violently with combustible materials. Some materials which are noncombustible in air may burn in the presence of an oxidizer. Use of water may result in the formation of very toxic aqueous solutions. Move away from container and cool with water from a protected position. Keep containers and surroundings cool with water spray. Do not allow run-off from fire fighting to enter drains or water courses. If possible, stop flow of product.
- Special protective equipment for fire-fighters : Use self-contained breathing apparatus and chemically protective clothing. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask. EN 943-2: Protective clothing against liquid and gaseous chemicals, aerosols and solid particles. Gas-tight chemical protective suits for emergency teams.

6. ACCIDENTAL RELEASE MEASURES

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

- Personal precautions : Evacuate personnel to safe areas. Use self-contained breathing apparatus or positive pressure air line with mask and escape pack in areas where concentration is unknown or above the exposure limits. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe. Ventilate the area.
- Environmental precautions : Should not be released into the environment. Prevent further leakage or spillage if safe to do so.
- Methods for cleaning up : Ventilate the area. Approach suspected leak areas with caution.
- Additional advice : If possible, stop flow of product. If leak is from cylinder or cylinder valve, call the emergency telephone number. If the leak is in the user's system, close the cylinder valve, safely vent the pressure, and purge with an inert gas before attempting repairs. Increase ventilation to the release area and monitor concentrations.

7. HANDLING AND STORAGE

Handling

Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not allow storage area temperature to exceed 50°C (122°F). Before using the product, determine its identity by reading the label. Know and understand the properties and hazards of the product before use. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use. Use an adjustable strap wrench to remove over-tight or rusted caps. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Ensure the complete gas system is compatible for pressure rating and materials of construction. Ensure the complete gas system has been checked for leaks before use. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Open valve slowly. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. Close valve after each use and when empty. Replace outlet caps or plugs and container caps as soon as container is disconnected from equipment. Do not subject containers to abnormal mechanical shock. Never attempt to lift a cylinder by its valve protection cap or guard. Do not use containers as rollers or supports or for any other purpose than to contain the gas as supplied. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. Keep container valve outlets clean and free from contaminants particularly oil and water. Do not smoke while handling product or cylinders. Never re-compress a gas or a gas mixture without first consulting the supplier. Never attempt to transfer gases from one cylinder/container to another. Always use backflow protective device in piping. Purge system with dry inert gas (e.g. helium or nitrogen) before gas is introduced and when system is placed out of service. Avoid suckback of water, acid and alkalis. Installation of a cross purge assembly between the cylinder and the regulator is recommended. When returning cylinder install valve outlet cap or plug leak tight. Never permit oil, grease, or other readily combustible substances to come into contact with valves or containers containing oxygen or other oxidants. Do not use rapidly opening valves (e.g. ball valves). Open valve slowly to avoid pressure shock. Never pressurize the entire system at once. Use only with equipment cleaned for oxygen service and rated for cylinder pressure. Never use direct flame or electrical heating devices to raise the pressure of a container. Containers should not be subjected to temperatures above 50°C (122°F).

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

Storage

Containers should be stored in the vertical position and properly secured to prevent toppling. The container valves should be tightly closed and where appropriate valve outlets should be capped or plugged. Container valve guards or caps should be in place. Full containers should be stored so that oldest stock is used first. Keep containers tightly closed in a cool, well-ventilated place. Stored containers should be periodically checked for general condition and leakage. Observe all regulations and local requirements regarding storage of containers. Local codes may have special requirements for toxic gas storage. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Keep container tightly closed in a dry and well-ventilated place. Full and empty cylinders should be segregated. Do not allow storage temperature to exceed 50°C (122°F). Display "No Smoking or Open Flames" signs in the storage areas. Return empty containers in a timely manner.

Technical measures/Precautions

Containers should be segregated in the storage area according to the various categories (e.g. flammable, toxic, etc.) and in accordance with local regulations. Keep away from combustible material. Where necessary containers containing oxygen and oxidants should be separated from flammable gases by a fire resistant partition. Segregate from flammable gases and other flammable materials in store.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures

Provide natural or mechanical ventilation to prevent accumulation above exposure limits.
Provide readily accessible eye wash stations and safety showers.

Personal protective equipment

- Respiratory protection : Keep self contained breathing apparatus readily available for emergency use. Users of breathing apparatus must be trained. Use gas filters and full face mask, where exposure limits may be exceeded for a short-term period, e.g. connecting or disconnecting containers. Gas filters do not protect against oxygen deficiency. Gas filters may be used if all surrounding conditions e.g. type and concentration of the contaminant(s) and duration of use are known. Standard EN 14387 - Gas filter(s), combined filter(s) and full face mask - EN 136. Consult respiratory device supplier's product information for the selection of the appropriate device. Self contained breathing apparatus is recommended, where unknown exposure may be expected, e.g. during maintenance activities on installation systems. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask.
- Hand protection : Wear working gloves when handling gas containers. Standard EN 388 - Protective gloves against mechanical risk. Wear chemically resistant protective gloves. Standard EN 374 - Protective gloves against chemicals. Consult glove manufacturer's product information on material suitability and material thickness. The breakthrough time of the selected gloves must be greater than the intended use period. Gloves must be clean and free of oil and grease.
- Eye protection : Wear safety glasses with side shields. Wear goggles and a face shield when transfilling or breaking transfer

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

connections.
Standard EN 166 - Personal eye-protection.

Skin and body protection : Safety shoes are recommended when handling cylinders.
Standard EN ISO 20345 - Personal protective equipment - Safety footwear.
Keep suitable chemically resistant protective clothing readily available for emergency use.
Standard EN943-1 - Full protective suits against liquid, solid and gaseous chemicals.

Special instructions for protection and hygiene : Ensure adequate ventilation, especially in confined areas. Provide good ventilation and/or local exhaust to prevent accumulation of concentrations above exposure limits.

Exposure limit(s)

Nitrogen monoxide	Time Weighted Average (TWA): EU ELV	25 ppm	30 mg/m ³
Nitrogen monoxide	Time Weighted Average (TWA): EU SCOELS	2 ppm	2.5 mg/m ³

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Compressed gas. Colorless gas

Odor : Irritating. Poor warning properties at low concentrations.

Odor threshold : No data available.

pH : Not applicable.

Melting point/range : -263 °F (-164 °C)

Boiling point/range : -242 °F (-152 °C)

Flash point : Not applicable.

Evaporation rate : Not applicable.

Flammability (solid, gas) : Refer to product classification in Section 2

Upper/lower explosion/flammability limit : No data available.

Vapor pressure : Not applicable.

Water solubility : 0.067 g/l

Relative vapor density : 1 (air = 1)

Relative density : 1.3 (water = 1)

Partition coefficient (n-octanol/water) : Not applicable.

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

Auto-ignition temperature : No data available.
Decomposition temperature : No data available.
Viscosity : Not applicable.
Molecular Weight : 30 g/mol
Density : 0.075 lb/ft³ (0.0012 g/cm³)

10. STABILITY AND REACTIVITY

Chemical Stability : Stable under normal conditions.
Reactivity/Incompatible Materials : Oxygen.
Flammable materials.
Organic materials.
Avoid oil, grease and all other combustible materials.
Hazardous decomposition products : Decomposes at room temperature to other nitrogen oxides and nitrogen.
Oxidises in air to form nitrogen dioxide which is extremely reactive.

11. TOXICOLOGICAL INFORMATION

Likely routes of exposure

Effects on Eye : Irritating to eyes. Causes severe eye burns.
Effects on Skin : Causes skin irritation. Causes skin burns.
Inhalation Effects : Irritating to respiratory system. Can cause severe lung damage. Delayed adverse effects possible. Prolonged exposure to small concentrations may result in pulmonary edema. Delayed fatal pulmonary edema possible.
Ingestion Effects : No data available.
Symptoms : No data available.

Acute toxicity

Acute Oral Toxicity : No data is available on the product itself.
Inhalation : LC50 (1 h) : 115 ppm Species : Rat.
Acute Dermal Toxicity : No data is available on the product itself.
Skin corrosion/irritation : Causes skin burns.
Serious eye damage/eye irritation : Risk of serious damage to eyes.

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

Sensitization. : No data available.

Chronic toxicity or effects from long term exposures

Carcinogenicity : No data available.

Reproductive toxicity : No data is available on the product itself.

Germ cell mutagenicity : This product or a component was mutagenic in a bacterial assay and in a cultured mammalian cell assay.

Specific target organ systemic toxicity (single exposure) : No data available.

Specific target organ systemic toxicity (repeated exposure) : No data available.

Aspiration hazard : No data available.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Aquatic toxicity : No data is available on the product itself.

Toxicity to other organisms : No data available.

Persistence and degradability

Biodegradability : No data is available on the product itself.

Mobility : Because of its high volatility, the product is unlikely to cause ground pollution.

Bioaccumulation : Refer to Section 9 "Partition Coefficient (n-octanol/water)".

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products : In accordance with local and national regulations. Contact supplier if guidance is required. Return unused product in original cylinder to supplier. Must not be discharged to atmosphere. Refer to the EIGA code of practice Doc. 30 "Disposal of Gases", downloadable at <http://www.eiga.org> for more guidance on suitable disposal methods. List of hazardous waste codes: 16 05 04: Gases in pressure containers (including halons) containing dangerous substances.

Contaminated packaging : Return cylinder to supplier.

14. TRANSPORT INFORMATION

ADR

UN/ID No. : UN1660

Proper shipping name : NITRIC OXIDE, COMPRESSED

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

Class or Division : 2
Tunnel Code : (D)
Label(s) : 2.3 (5.1, 8)
Marine Pollutant : No

IATA

Transport Forbidden

IMDG

UN/ID No. : UN1660
Proper shipping name : NITRIC OXIDE, COMPRESSED
Class or Division : 2.3
Label(s) : 2.3 (5.1, 8)
RQ Substance : Yes
Marine Pollutant : No
Segregation Group: : None

* NOTE: This product contains a USDOT Hazardous Substance and will meet the Reportable Quantity definition when shipped to, from, or within the United States, in the amount specified in 49CFR 172.101 Appendix A.

RID

UN/ID No. : UN1660
Proper shipping name : NITRIC OXIDE, COMPRESSED
Class or Division : 2
Label(s) : 2.3 (5.1, 8)
Marine Pollutant : No

Further Information

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

15. REGULATORY INFORMATION

Workplace Safety and Health Act & Workplace Safety and Health (General Provisions) Regulations

Workplace Health and Safety Act , SS586 Labeling.

Poison Act (Health Sciences Authority).

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
Japan	ENCS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.

SAFETY DATA SHEET

Version 2.2
Revision Date 02.08.2016

SDS Number 300000000098
Print Date 16.12.2017

16. OTHER INFORMATION

Ensure all national/local regulations are observed.

Prepared by : Versum Materials, Product Regulatory Department

For additional information, please visit our Versum Materials' Product Stewardship web site.
<http://www.versummaterials.com/productstewardship/>
