MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 1686b
MSDS Number: 1686b
SRM Name: Nitric Oxide in Nitrogen (Nominal Amount of Substance Fraction: 500 µm/mol)

Date of Issue: 14 July 2006

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Description: This SRM mixture is supplied in a DOT 3AL specification aluminum (6061 alloy) cylinder with a water volume of 6 L. Mixtures are shipped with a nominal pressure exceeding 12.4 MPa (1800 psi), which provides the user with 0.73 m^3 (25.8 ft^3) of useable mixture. The cylinder is the property of the purchaser and is equipped with a CGA-660 stainless steel valve, which is the recommended outlet for this nitric oxide mixture. NIST recommends that this cylinder **NOT** be used below 0.7 MPa (100 psi).

Substance: Nitric Oxide/Nitrogen Compressed Gas Mixture.

Other Designations: Nitric Oxide (nitrogen oxide; nitric oxide trimer; nitrogen monooxide)/**Nitrogen** (dinitrogen) compressed gas mixture.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration
Nitric Oxide	10102-43-9	233-271-0	500 µmol/mol *
Nitrogen	7727-37-9	231-783-9	balance

* Concentration applies to the identified NIST cylinder.

Index, R/S Phrases (EU): Refer to Section 15, “Regulatory Information”.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0–4): Health = 4 Fire = 0 Reactivity = 1

Major Health Hazards: Potentially fatal if inhaled, respiratory tract irritation, skin irritation, eye irritation, blood disorders.

Physical Hazards: Cylinder may rupture or explode if exposed to heat. May ignite combustibles. May react on contact with water and/or air. Releases toxic, corrosive, flammable or explosive gases.

Potential Health Effects (Short Term Exposure)

Inhalation: Potentially fatal if inhaled. Lung congestion, irritation, chest pain, difficulty breathing, nausea, vomiting, stomach pain, irregular heartbeat, headache, dizziness, bluish skin color.

Skin Contact: Irritation. Burns.

Eye Contact: Irritation. Burns.

Ingestion: Ingestion of a gas is unlikely.

Listed as a Carcinogen/Potential Carcinogen

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

4. FIRST AID MEASURES

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration by qualified personnel. Get immediate medical attention.

Skin Contact: Wash affected skin with soap and water for at least 15 minutes while removing contaminated clothing. Get medical attention, if needed.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Get immediate medical attention.

Ingestion: Ingestion of gas is unlikely.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Negligible fire hazard applicable to the identified NIST cylinder. Cylinder may rupture or explode if exposed to heat. Escaping gas mixture promotes combustion of surrounding materials.

Extinguishing Media: Water.

Fire Fighting: Move cylinder from fire area if it can be done without risk. Avoid inhalation of material or combustion by-products. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): Not Applicable **Autoignition (°C):** Not Applicable **Method:** Not Applicable

Flammability Limits in Air (Volume %): Upper: Not Applicable

Lower: Not Applicable

Flammability Class (OSHA): Not applicable to the identified cylinder.

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Stop leak if possible without personal risk. Isolate hazard area and deny entry. Stay upwind and keep out of low areas. Refer to Section 13, "Disposal Considerations".

7. HANDLING AND STORAGE

Storage: Store and handle in accordance with all current regulations and standards. Secure cylinder to prevent physical damage. Keep valve protective cap on cylinder when not in use. Keep separated from incompatible substances. Store in a well-ventilated area. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101.

Safe Handling Precautions: Wear safety goggles. See Section 8, "Exposure Controls and Personal Protection".

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitrogen Gas

ACGIH (inhalation): simple asphyxiant
UK OES (inhalation): simple asphyxiant

Nitric Oxide

OSHA TWA (inhalation): 30 mg/m^3 (25 ppm)
ACGIH TWA (inhalation): 30 mg/m^3 (25 ppm)
NIOSH (recommended TWA, 10 h): 30 mg/m^3 (25 ppm)
EC OEL (inhalation): 30 mg/m^3 (25 ppm)

Ventilation: Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

Respirator: If necessary, refer to the "NIOSH Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84" for selection and use of respirators with organic vapor cartridges certified by NIOSH.

Eye Protection: Wear safety goggles. An eye wash station and quick drench shower should be readily available near of handling and use areas.

Personal Protection: Wear protective clothing and chemically resistant gloves to prevent skin exposure.

9. Physical and Chemical Properties

Nitrogen Gas	Nitric Oxide Gas
Appearance and Odor: colorless, odorless	**Appearance, Odor, Taste:** colorless, pungent odor
Relative Molecular Mass: 28.01	**Relative Molecular Mass:** 30.01
Molecular Formula: N_2	**Molecular Formula:** NO
Boiling Point (°C): –196	**Boiling Point (°C):** not available
Freezing Point (°C): –210	**Freezing Point (°C):** –162
Vapor Density (air = 1): 0.97	**Vapor Density (air = 1):** 1.04
Volatility (%): 100	**Volatility (%):** not applicable
Solubility in Water (%): 1.6 @ 20 °C	**Solubility in Water (%):** 4.6
Solvent Solubility: soluble in liquid ammonia; slightly soluble in alcohol	**Solvent Solubility:** soluble in sulfuric acid, alcohol, ferrous sulfate solutions, carbon disulfide

10. Stability and Reactivity

Stability: X Stable _____ Unstable

Stable at normal temperature and pressure. Stability classification applies to the identified NIST cylinder. Nitric oxide, as a pure chemical, may react on contact with water or with air. Releases toxic, corrosive, flammable or explosive gases. May explode during distillation or evaporation.

Conditions to Avoid: Avoid contact with combustible materials. Minimize contact with material. Avoid inhalation of material or combustion by-products. Keep out of water supplies and sewers. Protect from physical damage. Cylinder may rupture or explode if exposed to heat.

Incompatibilities: Metals, bases, metal oxides, reducing agents, combustible materials, halo carbons, oxidizing materials, halogens, metal carbide, metal salts.

Fire/Explosion Information: Refer to Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Thermal decomposition or combustion produces oxides of nitrogen.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. Toxicological Information

Route of Entry: X Inhalation _____ Skin _____ Ingestion

Nitrogen Gas

Compressed nitrogen gas is a simple asphyxiant.

Nitric Oxide Gas

TC_{LO} (inhalation-human): 76 mg/m^3
LC_{50} (inhalation-rat): 160 mg/m^3
TC_{LO} (inhalation-rat): 140 mg/m^3

Health Effects (Acute Exposure):

Inhalation of low concentrations of nitric oxide, in a one time exposure may produce no immediate reaction or may cause mild coughing, respiratory tract irritation, fatigue, nausea, headache, and vomiting. After exposure to fresh air, the symptoms may no longer persist. A 60 minute exposure to 25 ppm may cause irritation and minor chest pain; 50 ppm may lead to pulmonary edema with possible recovery; 100 ppm may cause pulmonary edema and death. In addition to the preceding symptoms, exposure to low concentrations for an eight hour period of time may cause choking, abdominal pain, and dyspnea. This may last five to forty-eight hours. After this period of time, the second phase of symptoms may begin to appear including slight respiratory discomfort, headache, dizziness, nausea, vomiting, cyanosis of lips and ears, difficulty breathing, irregular respiration, choking, tightness in chest, lassitude, pulmonary edema, palpitation and possibly death if untreated. This condition is also known as "silo fillers disease." The syndrome is identified in farmers who suffer from intoxication of nitrogen oxide build-up in silos. Nitrogen dioxide is formed readily in air and the effects from this oxidation product may be more significant than nitric oxide.

The symptoms of asphyxia depend on the rapidity with which the oxygen deficiency develops and how long it continues. In sudden acute asphyxia, unconsciousness may be immediate. With slow development, there may be rapid respiration and pulse, air hunger, dizziness, reduced awareness, tightness in the head, tingling sensations, incoordination, faulty judgment, emotional instability, and rapid fatigue. As the asphyxia progresses, nausea, vomiting, collapse, unconsciousness, convulsions, deep coma and death are possible.

Target Organs: Blood.

Medical Conditions Generally Aggravated by Exposure: Respiratory disorders.

12. ECOLOGICAL INFORMATION

Environmental Summary: No data available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose in accordance with all applicable federal, state, and local regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): DOO1. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): P076.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Compressed Gas, N.O.S. (Nitric Oxide in Nitrogen); UN1956; Hazard Class 2.2.

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4): Not applicable to the identified NIST cylinder.

SARA Title III Section 302 (40 CFR 355.30): Not applicable to the identified NIST cylinder.

SARA Title III Section 304 (40 CFR 355.40): Not applicable to the identified NIST cylinder.

SARA Title III Section 313 (40 CFR 372.65): Not applicable to the identified NIST cylinder.

OSHA Process Safety (29 CFR 1910.119): Not applicable to the identified NIST cylinder.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21)

ACUTE:	Yes
CHRONIC:	No
FIRE:	Not applicable to the identified NIST cylinder.
REACTIVE:	No
SUDDEN RELEASE:	Yes

STATE REGULATIONS

California Proposition 65: Not regulated.

CANADIAN REGULATIONS

WHMIS Classification: Not determined.

EUROPEAN REGULATIONS

EU Classification

Nitrogen: Not determined.

Nitric Oxide:

O	Oxidizing.
T	Toxic.
Xi	Irritant.

EU Risk and Safety Phrases

Nitrogen: Not determined.

Nitric Oxide:

R 8	Contact with combustible material may cause fire.
R 23	Toxic by inhalation.
R 36	Irritating to eyes.
R 37	Irritating to respiratory system.
R 38	Irritating to skin.

S 1	Keep locked-up.
S 2	Keep out of the reach of children.
S 4	Keep away from living quarters.
S 13	Keep away from food, drink and animal feedingstuffs.
S 20	When using do not eat or drink.
S 24	Avoid contact with skin.
S 25	Avoid contact with eyes.
S 26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 35	This material and its container must be disposed of in a safe way.
S 36	Wear suitable protective clothing.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label if possible).
S 46	If swallowed, seek medical advice immediately and show this container or label.

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): Listed on inventory.

TSCA 12(b), Export Notification: Not listed.

16. OTHER INFORMATION

Sources: MDL Information Systems, Inc., MSDS *Nitrogen*, 16 June 2005.
MDL Information Systems, Inc., MSDS *Nitric Oxide*, 15 March 2006.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.