



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards and EC Standards

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: 12 ppm - < 2.3% NITRIC OXIDE IN NITROGEN
CHEMICAL NAME: Mixture of Nitric Oxide (12 ppm - < 2.3%) and Nitrogen (Balance)
FORMULA: Nitric Oxide = NO; Nitrogen = N₂
SYNONYMS: Not Applicable

MANUFACTURER: SPECTRA GASES, INC.
ADDRESS: 3434 Route 22 West
 Branchburg, NJ 08876, U.S.A.
PHONE: 908/252-9300
FAX: 908/252-0811

SPECTRA GASES EMERGENCY CONTACT: 800-932-0624 8:30 am - 7:00 pm (EST)
24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 202/484-7616
REVISION DATE: April 4, 2005
MSDS NUMBER: 1611a
PRODUCT USE: Environmental Calibration and Auditing Gas

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Nitric Oxide 12 ppm - < 2.3%, Balance Nitrogen
CAS NUMBER: Nitric Oxide: 10102-43-9
 Nitrogen: 7727-37-9
EINECS NUMBER: Nitric Oxide: 233-271-0
 Nitrogen: 231-783-9

EXPOSURE LIMITS:

	OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
Nitric Oxide:	TWA = 25 ppm	TWA = 25 ppm	TWA = 25 ppm IDLH = 100 ppm

Nitrogen:
 There are no exposure limits for Nitrogen, Nitrogen is a simple asphyxiant.

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless, non-flammable gas mixture, with a pungent, irritating odor, shipped under pressure. This gas mixture can produce significant, adverse health effects, due to the Nitric Oxide content, which can reach exposure limits at the percentage in this mixture. This gas mixture may be toxic by inhalation, if duration of exposure is prolonged. Symptoms of such overexposure may not become apparent for up to 72 hours (see below for more information). In the presence of air, Nitric Oxide forms brown fumes of nitrogen dioxide which are corrosive. A water spray can be used to control and direct a release. Additionally, releases of this gas mixture may produce oxygen-deficient atmospheres; individuals in such atmospheres may be asphyxiated. Emergency Responders must protect themselves from inhalation exposures.

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING - If rescue personnel need to enter an area suspected of having a toxic level of Nitric Oxide, they should be equipped with Self-Contained Breathing Apparatus (SCBA), and, if available, a full-body chemically resistant suit. Acute overexposure to this gas mixture may cause the following health effects:

EYE CONTACT: If the gas mixture contaminates the eyes, moderate to severe injury and swelling of the eye tissue may occur, depending on duration of exposure. Release of a high-pressure gas may result in airborne objects.

SKIN CONTACT: This gas mixture may irritate the skin, especially if exposure occurs in a moist environment for prolonged periods. Symptoms of skin overexposure may include scratchiness, pain, and redness.

INGESTION: Ingestion of this gas mixture is not a likely route of industrial exposure.

SECTION 3. HAZARD IDENTIFICATION (Continued)

INHALATION: This gas mixture can produce significant health effects, due to the presence of Nitric Oxide, which can produce, adverse health effects at the concentration in this mixture. At low levels, irritation of the respiratory system may occur. After a serious over exposure to this gas mixture, there may be no immediate reaction or only a very slight respiratory discomfort, headache, dizziness, or lassitude. Within 5-8 hours of exposure it may be noticed that the victim's lips and ears have a blue (cyanotic) color. There then follows rapidly increasing symptoms of breathing difficulty, irregular respiration, choking, dizziness, headache, increasing cyanosis, tightness in the chest, nausea, vomiting, lassitude, palpitations, accelerated respiratory rate, decreased vital capacity, generally suppressed breathing sounds, low blood pressure, and a platelet count elevated by 10-100%. If this gas mixture is inhaled, symptoms from Nitric Oxide which may develop include those described below.

**CONCENTRATION
of NITRIC OXIDE****EXPOSURE SYMPTOM**

25 ppm

With an exposure time of an 8-hour work shift; pulmonary irritation, tightness in chest, headache, irritation of eyes, nausea and slow loss of strength. Symptoms can be delayed 5-72 hours.

100 - 150 ppm

With an exposure time of 30-60 minutes; symptoms of pulmonary dysfunction, delayed pulmonary edema.. Symptoms can be delayed 5-48 hours.

200 - 700 ppm

With any length of exposure; severe pulmonary damage, including fatal pulmonary edema. Symptoms may be delayed 5-8 hours.

An additional health hazard associated with this gas mixture is asphyxiation after inhalation of oxygen-deficient environments. If large volumes of this gas mixture are released or if this gas mixture is released in poorly-ventilated areas (i.e., enclosed or confined spaces), an oxygen-deficient environment may occur. It should be noted that before adverse health effects or suffocation could occur, the effects of overexposure to Nitric Oxide will be felt. Individuals breathing an oxygen-deficient atmosphere may experience symptoms that include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. The following effects associated with various levels of oxygen are as follows:

**CONCENTRATION
of OXYGEN****EXPOSURE SYMPTOM**

20.9% Oxygen:

Normal oxygen concentration in air.

15-19% Oxygen:

Decreased ability to perform tasks. May impair coordination and may induce early symptoms in persons with heart, lung, or circulatory problems.

12-15% Oxygen:

Breathing increases, especially in exertion. Pulse up. Impaired coordination, perception, and judgment.

10-12% Oxygen:

Breathing further increases in rate and depth, poor coordination and judgment, lips slightly blue.

8-10% Oxygen:

Mental failure, fainting, unconsciousness, ashen face, blueness of lips, nausea (upset stomach), and vomiting.

6-8% Oxygen:

8 minutes, may be fatal in 50-100% of cases; 6 minutes, may be fatal in 25 to 50% of cases; 4-5 minutes, recovery with treatment.

4-6% Oxygen:

Coma in 40 seconds, followed by convulsion, breathing failure, death.

WARNING: Exposure to atmospheres containing 8-10% or less oxygen will bring about unconsciousness without warning and so quickly that individuals cannot help or protect themselves. Lack of sufficient oxygen may cause serious injury or death.

SKIN CONTACT: Not applicable.

HMIS RATINGS: HEALTH: = 2; FLAMMABILITY: = 0; REACTIVITY: = 0;

PPE: Level B (see Section 8, Exposure Controls/Personal protective Equipment)

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation, skin contact.

TARGET ORGANS: Respiratory system, olfactory system, reproductive system, skin and teeth.

SYMPTOMS: Prolonged or repeated overexposures to this gas mixture may cause bronchitis, hacking cough, nasal irritation and discharge, increased fatigue, and alteration in the senses of taste and smell. Repeated exposure to the skin may cause dermatitis. Prolonged exposure to this gas mixture may cause potentially harmful amounts of Nitric Oxide to enter the body via absorption through the skin. Repeated overexposures to this gas mixture can also result in dental erosion and gum disorders. Nitric oxide has been shown to cause genetic damage and fetal toxicity in animal or bacterial studies. See Section 11 (Toxicological Information) for additional information.

SECTION 3. HAZARD IDENTIFICATION (Continued)

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Acute or chronic respiratory conditions and cardiac conditions may be aggravated by over-exposure to this gas mixture.

CARCINOGENICITY: Nitric Oxide is not found on the FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or IARC Carcinogenicity lists and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies.

SECTION 4. FIRST AID MEASURES

EYE CONTACT: If irritation of the eye develops after exposure to this gas, open victim's eyes while under gentle, lukewarm, running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention from an ophthalmologist.

INGESTION: Ingestion is an unlikely route of exposure for this gas.

INHALATION: All exposures to this gas mixture in which symptoms of respiratory difficulty occur should be considered serious and medical attention sought. Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary.

SKIN CONTACT: If irritation of the skin develops after exposure to gas mixture, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

NOTES TO PHYSICIANS: Administer oxygen, if necessary and treat symptoms. Patients with 40% carboxyhemoglobin or more and an uncompensated metabolic acidosis (arterial pH less than 7.4) should be managed aggressively with ventilatory support or hyperbaric oxygenation. Infuse sodium bicarbonate and balanced electrolyte solutions if blood analyses indicate a significant metabolic acidosis. Ancillary therapy for brain edema may be necessary if hypoxia has been severe. Ensure absolute bed rest for at least 48 hours; in severe poisonings, 2-4 weeks in bed may prevent sequelae. Watch for late neurological, psychiatric and cardiac complications.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not Applicable

AUTOIGNITION: Not Applicable

FLAMMABLE RANGE: Not Applicable

NFPA RATINGS:

HEALTH: = 2 FLAMMABILITY: = 0
 REACTIVITY: = 0 SPECIAL: None

EXTINGUISHING MEDIA: This is a non-flammable gas mixture; use fire-extinguishing media appropriate for the surrounding materials.

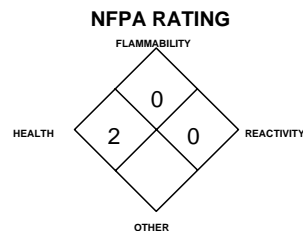
SPECIAL FIRE-FIGHTING PROCEDURES: Evacuate all personnel from area. If possible without risk, shut off source of gas, then fight fire according to types of materials burning. If cylinder is not actively a part of the fire, remove from fire area. If this is not possible, cool cylinder with a water spray to prevent violent rupture. Fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. If necessary, decontaminate fire-response equipment with soap and water solution.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture presents a significant inhalation hazard to firefighters, due to the presence of Nitric Oxide. This gas mixture does not burn; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not sensitive.

HAZARDOUS COMBUSTION PRODUCTS: If involved in a fire, the Nitric Oxide in this mixture will decompose to form oxides of nitrogen.



**See Section 16 for
 Definition of Ratings**

SECTION 6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: In the event of a leak of this product, operator should close the gas source if possible to do so safely. Evacuate immediate area. Only trained personnel, wearing Self-Contained Breathing Apparatus (SCBA) and a chemically resistant suit should re-enter a contaminated area.

If leak is in user's gas handling equipment or system, close cylinder valve, safely vent high pressure and purge with inert gas, being sure to bring purge gas to near atmospheric pressure before attempting repairs. If leak is from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

Levels of Nitric Oxide should be below applicable exposure levels listed in Section 2 (Composition / Information on Ingredients) before personnel can be allowed in the area without SCBA.

Detection systems should be available to monitor for leaks and to measure the level of Nitric Oxide.

SECTION 7. HANDLING AND STORAGE

STORAGE: Cylinders should be stored upright (with valve protection caps or plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. Consideration should be taken to install leak detection and alarm equipment for storage areas. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

HANDLING: This mixture can be dangerous and should only be handled by trained personnel. Wearing contact lenses is not recommended when handling this gas mixture. Spectra Gases, Inc., strongly recommends that this gas mixture only be handled in areas with extensive venting capabilities, preferably a gas handling cabinet.

Before using this gas, meticulous leak checking using inert gas is strongly recommended, particularly after new connections are made. Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body). Close valve after each use and when empty.

Nitric Oxide detectors are strongly recommended. Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Purge gas handling equipment with inert gas and relieve pressure before attempting repairs.

SPECIAL PRECAUTIONS: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers*. Local regulations may require specific equipment for storage and use.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Forced ventilation systems for the general work area should be provided. Spectra Gases, Inc. recommends that cylinders in use be secured within a ventilated enclosure such as a gas cabinet. Employee exposure should be monitored and reduced to the lowest practical levels using ventilation or other appropriate engineering controls. If appropriate, install automatic monitoring equipment to detect the level of Nitric Oxide.

RESPIRATORY PROTECTION: Maintain exposure levels of Nitric Oxide below the levels listed in Section 2 (Composition / Information on Ingredients) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Nitric Oxide levels exceed exposure limits, if oxygen level is below 19.5%, or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards, standards of Canada, the European Standard EN166, and EC member states. The following NIOSH respiratory protection recommendations are for Nitric Oxide.

CONCENTRATION of NITRIC OXIDE

Up to 100 ppm

RESPIRATORY EQUIPMENT

SAR (Supplied-Air Respirator) operated in a continuous-flow mode; or full-facepiece chemical cartridge respirator with cartridge(s); or powered air-purified respirator with cartridge(s); or gas mask with canister; or SAR; or full-facepiece SCBA.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued):

CONCENTRATION	RESPIRATORY EQUIPMENT
of NITRIC OXIDE	

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Escape: Gas mask with canister to protect against nitric oxide; or escape- type SCBA. The IDLH concentration for Nitric Oxide is 100 ppm.

EYE PROTECTION: Use approved safety goggles or safety glasses, as described in OSHA 29 CFR 1910.133 or by the European Standard EN166. Eye wash stations/safety showers should be available.

SKIN PROTECTION: Work (such as leather) gloves are recommended when handling cylinders of this gas mixture. Wear chemically-resistant gloves when using this gas. Natural rubber and neoprene are attacked by Nitric Oxide. Use chemical-resistant gloves in emergency situations. Use triple gloves for spill response.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require use of chemically impervious clothing.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

The following information is for Nitrogen, the component of greatest percentage:

MOLECULAR WEIGHT: 28.01

GAS DENSITY @ 21.1°C (70°F): 0.072 lb./ft³ (1.153 kg/m³)

BOILING POINT @ 1 atm: -195.8°C (-320.4°F)

FREEZING/MELTING POINT @ 1 atm: -210°C (-345.8°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 0.906

SOLUBILITY IN WATER vol/vol at 0°C (32°F) and 1 atm: 0.023

SPECIFIC VOLUME @ 21.1°C (70°F): 13.8 lb/ft³ (0.867 m³/kg)

CRITICAL PRESSURE: 492.9 psia (3399 kPa abs)

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for the Nitric Oxide component of this gas mixture.

ODOR THRESHOLD: 0.29-0.97 ppm

GAS DENSITY @ 21.1°C (70°F): 0.0777 lb/ft³ (1.245 kg/m³)

VAPOR PRESSURE @ 20°C (68°F): 26000 mm Hg

Information for gas mixture:

APPEARANCE, ODOR AND STATE: Colorless, with irritating odor.

WARNING PROPERTIES FOR THIS GAS MIXTURE: The odor of this gas mixture may be a warning property. It is recommended that a monitor for Nitric Oxide be used.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: This gas mixture will be stable at standard temperature and pressure.

CONDITIONS TO AVOID: Cylinders should not be exposed to temperatures in excess of 125°F (52°C).

MATERIALS WITH WHICH GAS MIXTURE IS INCOMPATIBLE: Due to the presence of Nitric Oxide, this gas mixture may be incompatible with oxygen, flammable or combustible materials, powdered aluminum, boron, chlorine monoxide, chromium, fluorine, nitrogen trichloride, ozone, phosphorous, oxidizing agents, halogens, powdered iron, sodium monoxide, magnesium, manganese, uranium, and tungsten carbide.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Upon exposure to air, Nitric Oxide will convert to Nitrogen Dioxide.

B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA ON COMPONENTS:

NITRIC OXIDE:

D.O.T. LC₅₀ = 115 ppm

Inhalation-Mouse LCLo: 320 ppm

Inhalation-mouse TCLo: 10 ppm/2

hours/30 weeks-intermittent: Lungs,

Thorax, or Respiration: emphysema;

Blood: pigmented or nucleated red

blood cells, changes in leukocyte

(WBC) count

Inhalation-Dog, adult LCLo: 5000 ppm/25
minutes

inhalation-Rat TCLo: 50 mg/m³/6 hours/7
weeks-intermittent

Inhalation-rat TCLo: 3 mg/m³/24 hours/16

days-continuous: Brain and Coverings:

recordings from specific areas of CNS;

Blood: methemoglobinemia-

carboxyhemoglobin; Biochemical:

Enzyme inhibition, induction, or change

in blood or tissue levels: true cholinesterase

Inhalation-Rat LC₅₀: 1068 mg/m³

Mutation in Microorganisms-Salmonella
typhimurium 30 ppm

Mutation in Mammalian Somatic Cells-Rat-

Inhalation 27 ppm/3 hours-continuous

Mutation in Mammalian Somatic Cells-Hamster:

lung 10 ppm/10 minutes-continuous

NITROGEN: Nitrogen is a simply asphyxiant.

CARCINOGENICITY: The components of this gas mixture have not been found to be carcinogenic.

IRRITANCY OF PRODUCT: This gas mixture irritates the respiratory system, eyes and may irritate the skin. Depending on duration and concentration, the irritation may be severe. In addition, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION OF PRODUCT: Nitric Oxide and Nitrogen (components of this gas mixture) are not known to cause sensitization in humans. One study involving guinea pigs exposed to 4.3 ppm Nitric Oxide, 8 hours/day for 5 days enhanced an allergic reaction to ovalbumin (a known allergen).

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas mixture and its components on the human reproductive system.

Mutagenicity: This gas mixture is not expected to cause mutagenic effects in humans.

Embryotoxicity: This gas mixture is not expected to cause embryotoxic effects in humans. Nitric Oxide (a component of this gas mixture) has been shown to cause genetic damage in bacterial studies

Teratogenicity: This gas mixture is not expected to cause teratogenic effects in humans.

Reproductive Toxicity: This gas mixture is not expected to cause adverse reproductive effects in humans. Nitric Oxide (a component of this gas mixture) has been shown to cause and fetal toxicity in animal studies.

A mutagen is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical that causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance that interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for the components of this gas mixture.

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas mixture will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this gas mixture. Complex reactions of Nitric Oxide occur in the atmosphere which contribute to air pollution.

NITRIC OXIDE: Water solubility = 7.34 cc/100 cc at 0°C, 2.3 ml

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C and 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on plants would be related to oxygen-deficient environments or frost from rapidly expanding gases, unless exposure occurs in a confined space. Because Nitric Oxide produces corrosive nitrogen dioxide, upon contact with air or moisture, plants may be damaged or destroyed.

EFFECT OF CHEMICAL ON AQUATIC LIFE: This gas mixture may have adverse effects on aquatic life.

MOBILITY: The components of this gas mixture will not be mobile in the soil.

PERSISTENCE AND BIODEGRADABILITY: Persistence: Nitrogen and Nitric Oxide present no hazard of persistence. Biodegradation: Nitrogen is fully biodegradable. Nitric Oxide reacts with air to nitrogen dioxide.

POTENTIAL TO BIOACCUMULATE: The components of this gas mixture do not have bioaccumulation or food chain contamination potential.

OZONE-DEPLETION POTENTIAL: The components of this gas mixture are not Class I or Class II ozone depleting chemicals (40 CFR Part 82).

SECTION 13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER: Do not dispose of residual product. Return residual product in cylinders to: Spectra Gases, Inc., 80 Industrial Drive, Alpha, NJ 08865 or Spectra Gases, Inc., 1261 Activity Drive, Vista, CA 92083.

DISPOSAL INFORMATION: Residual product in the system may be burned if suitable burning unit (flair incinerator) is available on-site. This shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EC member states.

SECTION 14. TRANSPORT INFORMATION**U.S. SHIPPING INFORMATION:**

U.S. DOT PROPER SHIPPING NAME: Compressed gases, n.o.s. (Nitrogen, Nitric Oxide)
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
U.S. DOT SHIPPING LABEL(S) REQUIRED: Non-Flammable Gas
PLACARD (When required): Not Applicable

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position in a well-ventilated truck (never transport in passenger compartment of a vehicle). Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

CAUTION: Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).

NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #: 126

CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas mixture is considered as dangerous goods; use the above information for the preparation of Canadian Shipments.

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):

IATA DESIGNATION: This gas mixture is considered as dangerous goods, per the International Air Transport Association.

PROPER SHIPPING NAME: Compressed gas, n.o.s. (Nitrogen, Nitric Oxide)
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
HAZARD LABEL(S) REQUIRED: Not Applicable

The following Packaging Information is applicable to this product:

PASSENGER AND CARGO AIRCRAFT				CARGO AIRCRAFT ONLY	
Limited Quantity		Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg
Packing Instruction	Max. Qty per Pkg				
//////	//////	200	75 kg	200	150 kg

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

IMO DESIGNATION: This gas mixture is considered as dangerous goods, per the International Maritime Organization.

PROPER SHIPPING NAME: Compressed gas, n.o.s. (Nitrogen, Nitric Oxide)
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
HAZARD LABEL(S) REQUIRED: Not Applicable
IMDG CODE: Page 2124
STOWAGE CATEGORY: Category A

MARINE POLLUTANT: The components of this product are not designated by the IMO to be Marine Pollutants.

EUROPEAN SHIPPING INFORMATION:

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This gas mixture is considered by the Economic Commission for Europe to be dangerous goods. Additional information is as follows:

SUBSTANCE IDENTIFICATION NO.: 1956
NAME OF SUBSTANCE: Compressed gas, n.o.s. (Nitrogen, Nitric Oxide)
HAZARD IDENTIFICATION NO.: 20
LABEL: 2
CLASS AND ITEM NUMBER: 2, 1°A

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:**EPA - ENVIRONMENTAL PROTECTION AGENCY:**

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1990
(40 CFR Parts 117 and 302)

Reportable Quantity (RQ): Nitric Oxide = 10 lbs (4.54)

SARA TITLE III: Superfund Amendment and Reauthorization Act

SECTIONS 302/304: Emergency Planning and Notification (40 CFR Part 355)

Extremely Hazardous Substances: Nitric Oxide is listed.

Threshold Planning Quantity (TPQ): Nitric Oxide = 100 lbs (45.4)

Reportable Quantity (RQ): Nitric Oxide = 10 lbs (4.54)

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: Yes

PRESSURE: Yes

DELAYED HEALTH: Yes

REACTIVITY: No

FIRE: No

SECTION 313: Toxic Chemical Release Reporting (40 CFR 372)

Releases of Nitric Oxide and Nitrogen do not require reporting under Section 313.

CLEAN AIR ACT:

SECTION 112 (r): Risk Management Programs for Chemical Accidental Release
(40 CFR Part 68)

Nitric Oxide is listed under Table 1 as a Regulated Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Release Prevention, as a flammable substance.

Threshold Planning Quantity (TPQ): Nitric Oxide = 10,000 lb (4,553 kg).

TSCA: Toxic Substances Control Act

The components of this gas mixture are listed on the TSCA Inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119: Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): Nitric Oxide = 250 lb (11.25 kg)

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: Nitric Oxide (a component of this gas mixture) is on the California Proposition 65 lists. **WARNING:** This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Nitric Oxide.

California - Permissible Exposure Limits for Chemical Contaminants: Nitrogen, Nitric Oxide.

Florida - Substance List: Nitrogen, Nitric Oxide.

Illinois - Toxic Substance List: Nitric Oxide.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: Nitrogen, Nitric Oxide.

Michigan - Critical Materials Register: Nitric Oxide.

Minnesota - List of Hazardous Substances: Nitric Oxide.

Missouri - Employer Information/Toxic Substance List: Nitric Oxide.

New Jersey - Right to Know Hazardous Substance List: Nitrogen, Nitric Oxide.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.

Pennsylvania - Hazardous Substance List: Nitrogen, Nitric Oxide.

Rhode Island - Hazardous Substance List: Nitrogen, Nitric Oxide.

Texas - Hazardous Substance List: Nitric Oxide.

West Virginia - Hazardous Substance List: Nitric Oxide.

Wisconsin - Toxic and Hazardous Substances: Nitric Oxide.

CANADIAN FEDERAL REGULATIONS:

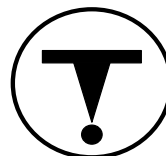
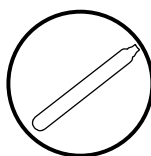
CANADIAN DSL INVENTORY STATUS: The components of this gas mixture are listed on the Canadian DSL Inventory.

OTHER CANADIAN REGULATIONS: This gas mixture is categorized as a Controlled Product, Hazard Classes A, and D2B as per the Controlled Product Regulations. The components of this product are not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS:

Class A: Compressed Gas

Class D2B: Toxic Material/Materials Causing Other Toxic Effects



SECTION 15. REGULATORY INFORMATION (Continued)**EUROPEAN ECONOMIC COMMUNITY REGULATIONS:**

EC LABELING AND CLASSIFICATION: This product does not meet the definition of any hazard class as defined by the European Community Council Directive 67/548/EEC.

EC CLASSIFICATION: Not applicable.

EC RISK PHRASES: Not applicable.

EC SAFETY PHRASES: Not applicable.

EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOL: Not applicable.

EUROPEAN COMMUNITY INFORMATION FOR COMPONENTS:**NITRIC OXIDE:**

EC EINECS/ELINCS NUMBER: 211-128-3

EC CLASSIFICATION: An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.

NITROGEN:

EC EINECS/ELINCS NUMBER: 231-783-9

EC CLASSIFICATION: An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.

SECTION 16. OTHER INFORMATION

Information contained in this Material Safety Data Sheet is provided to our customers so they may comply with 29 CFR 1910.1200, Hazard Communication Standard, the Canadian WHMIS Standard, and the requirements of the European Community Directives. The intent of this Material Safety Data Sheet is to provide end users of this product with the health and physical hazards associated with possible exposure to this product. All statements, technical data and recommendations are based on readily available texts and data that Spectra Gases, Inc., believes to be reliable and accurate. Spectra Gases, Inc., makes no warranties, guarantees or representations of any kind with respect to this product or this data. It is the responsibility of the user to obtain and use the most recent version of this MSDS.

Further information about compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 "Safe Handling of Compressed Gases in Containers"
 AV-1 "Safe Handling and Storage of Compressed Gases"
 "Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
 9163 Chesapeake Drive, San Diego, CA 92123-1002
 619/565-0302

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DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

TLV - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit (**STEL**), and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

The DFG - MAK is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL.

NIOSH is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDL₀**, the lowest dose to cause a symptom and **TCL₀** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

REGULATORY INFORMATION:

U.S. and CANADA: This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDSL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label.

EUROPEAN: EC is the European Community (formerly known as the **EEC**, European Economic Community). **EINECS**: This is the European Inventory of Now-Existing Chemical Substances. The **ARD** is the European Agreement Concerning the International Carriage of Dangerous Goods by Road and the **RID** are the International Regulations Concerning