



MATERIAL SAFETY DATA SHEET

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

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: 1 - 5000 ppm - NITROGEN DIOXIDE IN Air
CHEMICAL NAME: Mixture of Nitrogen Dioxide (1 - 5000 ppm) and Air (Balance)
FORMULA: Nitrogen Dioxide = NO₂; Air = Not Applicable
SYNONYMS: Not Applicable

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24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 202/484-7616
DATE OF PREPARATION: November 19, 1998
MSDS NUMBER: 1612b
PRODUCT USE: Environmental Calibration and Auditing Gas

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Nitrogen Dioxide 1 ppm - 5000 ppm, Balance Air
CAS NUMBER: Nitrogen Dioxide: 10102-44-0
 Air (compressed, atmospheric): 132259-10-0
EINECS NUMBER: Nitrogen Dioxide: 233-272-6
 Air (compressed, atmospheric): Unlisted

EXPOSURE LIMITS:

	OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
Nitrogen Dioxide:			
Ceiling = 5 ppm		TWA = 3 ppm	STEL = 1 ppm
STEL = 1 ppm (vacated 1989 PEL)		STEL = 5 ppm	IDLH = 20 ppm
		A4 (Not Classifiable as a Human Carcinogen)	
Air:			
Not Applicable			

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless to red-brown, non-flammable gas mixture with an acidic odor, shipped under pressure. Inhalation of this gas mixture can cause serious health effects and may be fatal. Symptoms of overexposure may not become apparent for up to 72 hours. This gas mixture may cause severe irritation and burns to skin, eyes, and other contaminated tissue. This gas mixture is not flammable. 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 Nitrogen Dioxide, 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 this gas mixture contaminates the eyes, severe injury and swelling of the eye tissue may occur. Release of a high-pressure gas may result in airborne objects.

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

SKIN CONTACT: Prolonged exposure may cause potentially harmful amounts of Nitrogen Dioxide, a component of this gas mixture, to enter the body via absorption through the skin. This gas mixture may be irritating to exposed skin, especially in a moist environment. Symptoms of skin overexposure may include scratchiness, pain, and redness.

INHALATION: Inhalation of Nitrogen Dioxide, a component of this gas mixture, in low concentrations produces an irritating effect on the mucous membranes of the eyes, nose, throat, and lungs. Symptoms may include dryness and irritation of the nose and throat, choking, coughing, and bronchospasm.

SECTION 3. HAZARD IDENTIFICATION (Continued)

INHALATION (Continued): Severe overexposure may cause death through systemic, delayed pulmonary edema. Exposure to high concentrations may also cause unconsciousness, and under some circumstances, death. Medical care after overexposure is essential, as symptoms will rapidly worsen, possibly leading to death. Repeated overexposures to Nitrogen Dioxide can cause dental erosion and gum disorders. Typical symptoms of overexposure are:

CONCENTRATION
of NITROGEN DIOXIDE

25 ppm:

100 - 150 ppm:

200 - 700 ppm:

EXPOSURE SYMPTOM

Delayed (5-72 hours) pulmonary irritation after 8 hours exposure.

Delayed (5-48 hours) pulmonary edema after exposure for 30 - 60 minutes.

Delayed (5-8 hours) severe pulmonary damage after only a few breaths.

OTHER HEALTH EFFECTS: Contact with rapidly expanding gases (which are released from under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain caused by frostbite can quickly subside, masking the injury. In addition, the sudden release of a pressurized gas (such as may occur in the event of a valve failure), presents a severe hazard of mechanical injury.

HMIS RATINGS: HEALTH: = 3; FLAMMABILITY: = 0; REACTIVITY: = 0;

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

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation, Skin Contact, Skin Absorption

TARGET ORGANS: Respiratory system, skin, eyes, reproductive system.

SYMPTOMS: Prolonged or repeated overexposures may cause respiratory problems, bronchitis, hacking cough, nasal irritation and discharge, increased fatigue, and alteration in the senses of taste and smell. Repeated overexposures to this gas mixture can also result in dental erosion and gum disorders. Nitrogen Dioxide, a component of this gas mixture, has been shown to cause genetic damage and fetal toxicity in animal or bacterial studies. Refer to Section 11 (Toxicology Information) for additional data.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing respiratory, dental, skin, and eye conditions may be aggravated by overexposure to this gas mixture.

CARCINOGENICITY: Nitrogen Dioxide, a component of this gas mixture, is listed as follows: ACGIH-A4 (Not Classifiable as a Human Carcinogen). Nitrogen Dioxide and Air are not found on the FEDERAL OSHA Z LIST, NTP, or CAL/OSHA, 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 mixture, 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: Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Victim must seek immediate medical attention.

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. In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

NOTES TO PHYSICIANS: Administer oxygen as soon as possible following exposure. Due to the presence of Nitrogen Dioxide in this gas mixture, be observant for signs of pulmonary edema. If possible, have victim breathe as deeply and rapidly as possible to help flush gas from the lungs. Enforce bed rest for 24 - 48 hours, whether or not symptoms have appeared. Start oxygen therapy at the first sign of symptoms. Provide medication to reduce anxiety and dyspnea, as needed. Keep respiratory tract clear of mucous and exudate. Atropine, epinephrine, expectorants, emetics, most sedatives, and most cardiac glycosides are usually ineffective and possibly harmful. Surgical intervention to assist breathing may be necessary. Respiratory infection should be controlled as soon as it is detected. Prednisone has been reported to be effective during recovery, in amounts of 3-8 x 10-6 kg daily, in divided doses. If this gas mixture contaminates the eye, use an optic anesthetic to reduce pain. The victim should be promptly examined by an ophthalmologist.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not Applicable

AUTOIGNITION: Not Applicable

FLAMMABLE RANGE: Not Applicable

NFPA RATINGS:

HEALTH: = 3 FLAMMABILITY: = 0
 REACTIVITY: = 0 SPECIAL: None

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

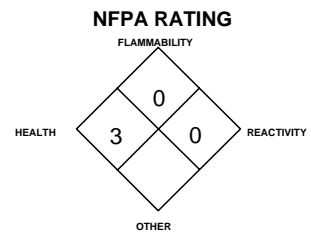
SPECIAL FIRE-FIGHTING PROCEDURES: Evacuate all personnel from area. If possible without risk, shut off source of gas, then fight fire according to types of materials burning. If cylinder is not actively a part of the fire, remove from fire area. If this is not possible, cool cylinder with a water spray to prevent violent rupture. Fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. If this product is involved in a fire, fire run-off water should be contained to prevent possible environmental damage. 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 Nitrogen Dioxide. Water spray should be used with care. Nitrogen Dioxide can slowly react with water to form a corrosive solution of nitric acid. Nitric acid is corrosive to skin and metal. Corrosive and toxic gases, vapors, and mists may spread from the point of release. 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: Not applicable.



**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. Persons responding to a release of a pressurized gas should be aware of the severe hazard of mechanical injury in the event of valve failure or other event causing a rapid release of cylinder contents.

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 Nitrogen Dioxide 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 Nitrogen Dioxide.

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. The failure of a valve can result in violent release of the pressurized gas, creating a severe mechanical injury hazard.

SECTION 7. HANDLING AND STORAGE

Nitrogen Dioxide 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 separate 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 Nitrogen Dioxide.

RESPIRATORY PROTECTION: Maintain exposure levels of Nitrogen Dioxide below the levels listed in Section 2 (Composition / Information on Ingredients). Use supplied air respiratory protection if Nitrogen Dioxide 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 EN149, and EC member states. The following NIOSH respiratory protection recommendations are for Nitrogen Dioxide.

CONCENTRATION

Up to 20 ppm:

Emergency or Planned Entry into

RESPIRATORY EQUIPMENT

Supplied Air Respirator (SAR) operated in a continuous-flow mode; or full facepiece Self-Contained Breathing Apparatus (SCBA); or full facepiece SAR.

Unknown Concentration or IDLH Conditions: Positive pressure, full facepiece SCBA or positive pressure, full facepiece SAR with an auxiliary positive pressure SCBA.

NOTE:

The IDLH concentration for Nitrogen Dioxide is 20 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. Neoprene gloves are recommended. 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 Air, the component of greatest percentage:

MOLECULAR WEIGHT: 28.975

GAS DENSITY @ 21.1°C (70°F): 0.07493 lb/ ft³ (1.2 kg/m³)

BOILING POINT @ 1 atm: -194.3°C (-317.8°F)

FREEZING/MELTING POINT @ 1 atm: -216.2°C (-357.2°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 1.00

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES (Continued)

SOLUBILITY IN WATER vol/vol at 0°C (32°F) and 1 atm: 0.0292

SPECIFIC VOLUME @ 21.1°C (70°F): 13.346 ft³/lb (0.8333 m³/kg)

CRITICAL PRESSURE (psia): 547 psia (3771 kPa abs)

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for the Nitrogen Dioxide component of this gas mixture.

ODOR THRESHOLD: 0.1 - 0.4 ppm (detection)

Information for gas mixture:

APPEARANCE, ODOR AND STATE: This is a colorless to red-brown, non-flammable gas mixture with an acidic odor.

WARNING PROPERTIES FOR THIS GAS MIXTURE: The pungent, acidic odor is a distinguishing characteristic of this gas mixture. The red-brown color of pure Nitrogen Dioxide is also characteristic.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.

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 Nitrogen Dioxide, this gas mixture is not compatible with strong bases, strong oxidizers, alkali metals, alkali earth metals, and powdered metals (e.g., powdered iron and aluminum).

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Nitrogen Dioxide, a component of this gas mixture, does not decompose, but reacts with water to form acidic solutions.

B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION**TOXICITY DATA ON COMPONENTS:**

AIR: Not applicable.

NITROGEN DIOXIDE:

LC₅₀ Inhalation, rat = 115 ppm - U.S. DOT

TCLo - Inhalation: Human - man: 6200 ppb/10 minutes; Lungs, Thorax, or Respiration - changes in pulmonary vascular resistance

TCLo - Inhalation: Human - man: 90 ppm/40 minutes; cough, dyspnea

LC₅₀ - Inhalation - rat: 88 ppm/4 hours;

LC₅₀ - Inhalation - mouse: 1000 ppm/10 minutes

LCLo - Inhalation - dog: 123 mg/m³/8 hours

LCLo - Inhalation - monkey: 123 mg/m³/8 hours

LC₅₀ - Inhalation - rabbit: 315 ppm/15 minutes

LC₅₀ - Inhalation - guinea pig: 30 ppm/1 hour

TCLo - Inhalation - rat: 2 ppm/24 hours/ 14 days (continuous); Lungs, Thorax, or Respiration changes; Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels; - dehydrogenases and other transferases

TCLo - Lowest published toxic concentration: Inhalation - rat: 5800 µg/m³/4 hours/ 17 weeks (intermittent); Behavioral - changes in motor activity; respiratory depression; other changes

TCLo - Inhalation - rat: 16 ppm/23 hours/ 74 weeks (continuous); Lungs, Thorax, or Respiration - bronchiolar constriction' Lungs, Thorax, or Respiration - emphysema; changes in lung weight

NITROGEN DIOXIDE (continued):

TCLo - Inhalation - rat: 3 ppm/24 hours/ 39 weeks (continuous); changes in lung weight; Biochemical - Metabolism (Intermediary) - lipids including transport

TCLo - Inhalation - rat: 2 ppm/24 hours/ 1 year (continuous); changes in lung weight

TCLo - Inhalation - rat: 4 ppm/24 hours/ 14 weeks (continuous); Lungs, Thorax, or Respiration changes; Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels; hepatic microsomal mixed oxidase; cytochrome oxidases (including oxidative phosphorylation)

TCLo - Inhalation - rat: 5700 µg/m³/6 hours/ 26 weeks (intermittent); Endocrine - other changes

TCLo - Inhalation - rat: 8 ppm/24 hours/ 7 days (continuous); Lungs, Thorax, or Respiration - other changes Immunological Including Allergic - decrease in cellular immune response; Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - dehydrogenases

TCLo - Inhalation - rat: 5 ppm/24 hours/ 4 weeks (continuous); Liver - other changes; Biochemical - Metabolism (Intermediary) - other proteins

TCLo - Inhalation - mouse: 250 ppb/7 hours/ 7 weeks (intermittent); Blood - changes in spleen Immunological Including Allergic - decrease in cellular immune response

NITROGEN DIOXIDE (continued):

TCLo - Inhalation - mouse: 20 ppm/24 hours/ 4 days (continuous); changes in spleen weight; changes in thymus weight; decrease in humoral immune response

TCLo - Inhalation - mouse: 10 ppm/2 hours/ 30 weeks (intermittent); Lungs, Thorax, or Respiration - fibrosis, focal (pneumoconiosis); Blood - pigmented or nucleated red blood cells

TCLo - Inhalation - guinea pig: 5800 µg/m³/4 hours/ 17 weeks (intermittent); Behavioral - changes in motor activity (specific assay); respiratory depression; Lungs, Thorax, or Respiration changes

TCLo (intermittent) inhalation - guinea pig: 15 ppm/24 hours/ 10 weeks (continuous); Kidney, Urethra, Bladder - other changes Blood - changes in spleen Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - dehydrogenases

TCLo - Inhalation - guinea pig: 3284 µg/m³/8 hours/ 26 weeks (intermittent); Brain and Coverings - other degenerative changes Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - multiple enzyme effects

TCLo - Inhalation - hamster: 30 ppm/22 hours/ 36 weeks (intermittent); Lungs, Thorax, or Respiration - structural or functional change in trachea or bronchi

SECTION 11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA ON COMPONENTS (continued):

NITROGEN DIOXIDE (continued):

TCLo - Inhalation - species unspecified: 10 ppm/4 hours/ 15 weeks (intermittent): Lungs, Thorax, or Respiration - fibrosis, focal (pneumoconiosis); Lungs, Thorax, or Respiration changes

TCLo - Inhalation - rat: 10 mg/m³/6 hours: female 1-22 day(s) after conception: Effects on Newborn - weaning or lactation index, growth statistics

TCLo - Inhalation - rat: 85 µg/m³/24 hours: female 1-22 day(s) after conception: Reproductive - Effects on Embryo or Fetus - fetotoxicity, fetal death

TCLo - Inhalation - rat: 800 µg/m³/24 hours: female 1-22 day(s) after conception: Reproductive - Fertility - litter size

TCLo - Inhalation - rat: 100 µg/m³/6 hours: female 1-22 day(s) after conception: Reproductive - Effects on Newborn - behavioral

NITROGEN DIOXIDE (continued):

TCLo - Inhalation - rat: 2360 µg/m³/12 hours: female 12 week(s) pre-mating: Reproductive: Maternal Effects: menstrual cycle changes or disorders Reproductive - Effects on Newborn - growth statistics

TDL0 - Inhalation - mouse: 22 ppm: female 7-18 day(s) after conception: Reproductive; Effects on Newborn: growth statistics; Reproductive - Effects on Newborn - behavioral

Mutation in microorganisms: Bacteria; Salmonella typhimurium: 6 ppm

Mutation in microorganisms: Bacteria; Salmonella typhimurium: 5 ppm

Mutation test systems - not otherwise specified: Bacteria - Salmonella typhimurium: 50 ppm

NITROGEN DIOXIDE (continued):

Mutation in microorganisms - Escherichia coli: 198 µg/L

Mutation test systems - not otherwise specified: Bacteria - Escherichia coli: 297 µg/L

Unscheduled DNA synthesis: Inhalation: Rodent - rat: 30 ppm/1 hour

Cytogenetic analysis - Inhalation - rat: 27 ppm/3 hours (continuous)

Mutation in mammalian somatic cells; Inhalation - rat: 15 ppm/3 hours (continuous)

DNA damage - hamster Lung: 10 ppm Cytogenetic analysis - hamster Fibroblast: 10 ppm/10 minutes (continuous)

Sister chromatid exchange - hamster Lung: 5 ppm/10 minutes (continuous)

CARCINOGENICITY: The ACGIH has listed Nitrogen Dioxide, a component of this mixture, as an A4 carcinogenic compound (Not Classifiable as a Human Carcinogen).

IRRITANCY OF PRODUCT: This gas mixture may be severely irritating to skin, eyes, and other contaminated tissue. In addition, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION OF PRODUCT: Nitrogen Dioxide and Air (components of this gas mixture) are not known to cause sensitization in humans.

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. Nitrogen Dioxide, a component of this mixture, has been shown to cause genetic damage in bacterial studies.

Embryotoxicity: This gas mixture is not expected to cause embryotoxic effects in humans.

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. Nitrogen Dioxide, a component of this mixture, has been shown to cause fetal toxicity and other reproductive effects 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. Complex reactions of Nitrogen Dioxide occur in the atmosphere which contribute to air pollution.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: This gas mixture may have adverse effects on animal life exposed to very high concentrations. Nitrogen Dioxide plant toxicity data are available, as follows: All species plants may be injured if exposed to atmospheric levels greater than 0.25 ppm for 1 month, 0.4 ppm for 1 week, or 0.8 ppm for 1 day.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Nitrogen Dioxide, a component of this gas mixture, hydrolyzes to nitric acid when in contact with water. If a release this product occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life.

SECTION 12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF CHEMICAL ON AQUATIC LIFE (continued): Specific aquatic toxicity data are as follows:

NITROGEN DIOXIDE:

Hematological (*Scienops ocellatus* Red drum) 24 hours - 3000 µg/L

LC₅₀ (*Penaeus penicillatus* redbtail prawn) 144 hours = 30330 µg/L

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

PERSISTENCE AND BIODEGRADABILITY: Persistence: Nitrogen Dioxide will react in the environment to generate nitrate compounds. Nitrate can persist for prolonged periods in natural waters.

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 unused 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 system can be neutralized using various caustic systems (e.g., soda lime; a wet, caustic scrubber; or a dry, charcoal scrubber). Neutralization should only be done by appropriately trained and experienced personnel. 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. (Air, Nitrogen Dioxide)

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. (Air, Nitrogen Dioxide)

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

SECTION 14. TRANSPORT INFORMATION (Continued)
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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. (Air, Nitrogen Dioxide)

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1956

HAZARD LABEL(S) REQUIRED: Not Applicable

STOWAGE CATEGORY: Category A

IMDG CODE: Page 2124

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. (Air, Nitrogen Dioxide)

HAZARD IDENTIFICATION NO.: 20

LABEL: 2

CLASS AND ITEM NUMBER: 2, 1^oA

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): Nitrogen Dioxide = 10 lb. (4.5 kg)

SARA TITLE III: Superfund Amendment and Reauthorization Act

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

Extremely Hazardous Substances: Nitrogen Dioxide is listed.

Threshold Planning Quantity (TPQ): Nitrogen Dioxide = 10 lb. (4.5 kg)

Reportable Quantity (RQ): Nitrogen Dioxide = 10 lb. (4.5 kg)

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 the components of this gas mixture do not require reporting under Section 313.

CLEAN AIR ACT:

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

Threshold Planning Quantity (TPQ): No component of this gas mixture is listed

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): Nitrogen Dioxide is listed in Appendix A of this regulation. The threshold quantity for Nitrogen Dioxide under this regulation is 250 lb. (113 kg)

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: No component of this gas mixture is a listed substance which the State of California requires warning under this statute.

SECTION 15. REGULATORY INFORMATION (Continued)

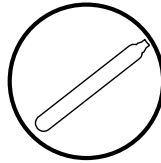
The components of this gas mixture are covered under the following specific U.S. State regulations:

Alaska - Designated Toxic and Hazardous Substances: Nitrogen Dioxide.	Massachusetts - Substance List: Nitrogen Dioxide.	Pennsylvania - Hazardous Substance List: Nitrogen Dioxide.
California - Permissible Exposure Limits for Chemical Contaminants: Nitrogen Dioxide.	Michigan - Critical Materials Register: Nitrogen Dioxide.	Rhode Island - Hazardous Substance List: Nitrogen Dioxide.
Florida - Substance List: Nitrogen Dioxide.	Minnesota - List of Hazardous Substances: Nitrogen Dioxide.	Texas - Hazardous Substance List: Nitrogen Dioxide.
Illinois - Toxic Substance List: Nitrogen Dioxide.	Missouri - Employer Information/Toxic Substance List: Nitrogen Dioxide.	West Virginia - Hazardous Substance List: Nitrogen Dioxide.
Kansas - Section 302/313 List: Nitrogen Dioxide.	New Jersey - Right to Know Hazardous Substance List: Nitrogen Dioxide.	Wisconsin - Toxic and Hazardous Substances: Nitrogen Dioxide.
	North Dakota - List of Hazardous Chemicals, Reportable Quantities: Nitrogen Dioxide.	

CANADIAN FEDERAL REGULATIONS:

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

CANADIAN WHMIS SYMBOLS: Class A: Compressed Gas



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

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:**NITROGEN DIOXIDE:**

EC EINECS/ELINCS NUMBER: 233-272-6

EC CLASSIFICATION: Very toxic. [T+]

EC RISK PHRASES: Very toxic by inhalation. [R: 12-26]

EC SAFETY PHRASES: Keep locked up and out of the reach of children.* **This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.* Keep container tightly closed and in a well ventilated place. Keep away from sources of ignition - No smoking. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). [S:(1/2-)* 7/9-16-45]

EC COMMENTS: In terms of Nitrogen Dioxide toxicity, use the following concentration limits:

C ≥ 10%: Very toxic by inhalation. [R: 26]

5% ≤ C < 10%: Toxic by inhalation. [R: 23]

1% ≤ C < 5%: Harmful by Inhalation [R: 23]

Product: This gas mixture contains less than 1% Nitrogen Dioxide and does not meet the requirements for classification and labeling for dangerous substances under European Community Standards.

AIR:

EC EINECS/ELINCS NUMBER: Not listed.

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.

SECTION 16. OTHER INFORMATION (Continued)

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

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 **TDLo**, the lowest dose to cause a symptom and **TCLo** 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** - 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/NDL**); 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 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