

MATERIAL SAFETY DATA SHEET

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

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **CARBON DIOXIDE, CARBON MONOXIDE/NITRIC OXIDE/NITROGEN GAS MIXTURE**

CHEMICAL FAMILY: Inorganic Gas Mixture

PRODUCT USE: Certified Standard

MANUFACTURER

MATHESON TRI-GAS, INC.

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PARSIPPANY, NJ 07054-0624
USA

Phone: 973/257-1100

EMERGENCY PHONE: **CHEMTREC DOMESTIC U.S.:** **1-800-424-9300**
CHEMTREC INTERNATIONAL: **1-703-527-3887**
CANUTEC (CANADA): **1-613-996-6666**

2. COMPOSITION and INFORMATION ON INGREDIENTS

(10,000 ppm = 1%)

CHEMICAL NAME	CAS #	mole % (range)	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-STEL		NIOSH IDLH ppm	OTHER ppm
			TWA ppm	STEL ppm	TWA ppm	STEL ppm		
Carbon Monoxide	630-08-0	≤ 1.0%	25	NE	50 35 (Vacated 1989 PEL)	200 (Vacated 1989 PEL)	1200	NIOSH RELs: TWA = 35 STEL = 200 (ceiling) DFG MAKs: TWA = 30 PEAK = 2•MAK, 15 min., average value DFG MAK Pregnancy Risk Classification: B
Nitric Oxide	10102-43-9	≤ 1.0%	25	NE	25	NE	100	NIOSH REL: TWA = 25
Carbon Dioxide	124-38-9	0-20.0%	5000	30,000	5000 10,000 (Vacated 1989 PEL)	30,000 (Vacated 1989 PEL)	40,000	NIOSH RELs: TWA = 5000 STEL = 30,000 DFG MAKs: TWA = 5000 PEAK = 2•MAK 15 min., average value, 1-hr interval
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1998 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

NE = Not Established

See Section 16 for Definitions of Terms Used.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless, corrosive, toxic, non-flammable gas mixture with an irritating odor. This gas mixture can be extremely irritating to the respiratory system and exposed tissue, due to the presence of Nitric Oxide. Inhalation may result in pulmonary edema, the symptoms of which can be delayed. This gas mixture can cause nausea, dizziness, headaches, and collapse, due to Carbon Monoxide. An additional health hazard associated with releases of this gas is from the effect of the Carbon Dioxide component of this gas mixture. At concentrations between 2-10%, Carbon Dioxide can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. If the concentration of Carbon Dioxide reaches 10% or more, suffocation can occur within minutes. Additionally, releases of this gas mixture may produce an oxygen-deficient atmosphere. Individuals in such atmospheres may be asphyxiated. Severe inhalation exposures may be fatal, due to Carbon Monoxide overexposure or asphyxiation. A cylinder rupture hazard exists with this gas mixture if subjected to heat or flames.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of over-exposure for this product are by inhalation and skin or eye contact.

INHALATION: This gas may be moderately to extremely irritating, depending on the concentration of Nitric Oxide present and the length of exposure. Symptoms can include tightness in the chest, headaches, nausea and a slow loss of strength. If inhaled, symptoms of exposure which can occur due to the presence of Nitric Oxide are described below:

NITRIC OXIDE

CONCENTRATION OBSERVED EFFECT

100-150 ppm:	Exposure at this level for 30-60 minutes could lead to delayed pulmonary edema.
200-700 ppm:	Several breaths at this concentration may result in fatal pulmonary edema after 5-8 hours have passed.

Usually no symptoms occur at the time of exposure, with the exception of a slight cough and perhaps fatigue and nausea. Exposure to low concentration may result in impaired pulmonary defense mechanisms (macrophages, cilia) with complications. A symptom-free period can follow exposure and last for 5-72 hours. Fatigue, uneasiness, restlessness, cough, hyperpnea, and dyspnea appear insidiously, as the adult respiratory distress syndrome gradually develops. Delayed symptoms may be severe after serious overexposure, and may include increased difficulty in breathing and chemical pneumonitis. If untreated these symptoms may be fatal. Sometimes a second acute phase follows the initial pulmonary reaction after a quiescent period of several weeks. Cough, tachypnea, dyspnea, fever, tachycardia and cyanosis at this stage are usually due to bronchiolitis obliterans. The relapse may be abrupt and fulminating, leading either to death or a slow convalescence. In non-fatal cases, convalescence may be complicated by infectious bronchitis, bronchiolitis obliterans, pneumonia and general asthenia. Rarely diffuse pulmonary fibrosis may develop. Although usually associated with high concentration inhalation exposure, there is also some hazard of the development of Methemoglobinemia, which is a syndrome in which the blood is unable to carry oxygen, due to formation of methemoglobin. The result can be cyanosis, with increased heart and respiratory rate, vertigo and vomiting. Death can occur in severe cases. Chronic inhalation of this gas mixture, may result in permanent decrease in pulmonary function (Silo Filler's Disease) or chronic irritation of the respiratory system, with cough, headache, loss of appetite, dyspepsia, tooth corrosion and gradual loss of strength.

Due to the presence of Carbon Monoxide, additional adverse effects may occur. Carbon Monoxide is classified as a chemical asphyxiant, producing a toxic action by combining with the hemoglobin of the blood and replacing the available oxygen. Since the affinity of Carbon Monoxide for hemoglobin is about 200-300 times that of oxygen, only a small amount of Carbon Monoxide will cause an adverse reaction to occur. Carbon Monoxide exposures in excess of 50 ppm will produce symptoms of poisoning if breathed for a sufficiently long time. If this gas mixture is inhaled, symptoms which may develop from Carbon Monoxide include those described below.

CARBON MONOXIDE

CONCENTRATION OBSERVED EFFECT

All exposure levels:	Overexposure to Carbon Monoxide can be indicated by the lips and fingernails turning bright red.
200 ppm:	Slight symptoms (headache, discomfort) after several hours of exposure.
400 ppm:	Headache and discomfort experienced within 2-3 hours of exposure.
1000 to 2000 ppm:	Within 30 minutes, slight palpitations of the heart occur. Within 1.5 hours, there is a tendency to stagger. Within 2 hours, there is mental confusion, headache, and nausea.
2000-2500 ppm:	Unconsciousness within 30 minutes.
2500 ppm:	Potential for collapse and death before warning symptoms are produced.

3. HAZARD IDENTIFICATION (Continued)

INHALATION (continued): The Carbon Dioxide component of this mixture is an asphyxiant and a powerful cerebral vasodilator. If the concentration of Carbon Dioxide reaches 10% or more, suffocation can occur rapidly. Inhalation of concentrations between 2 and 10% can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. Carbon Dioxide initially stimulates respiration and then causes respiratory depression. Inhalation of low concentrations (3-5%) have no known permanent harmful effects. Symptoms in humans at various levels of concentration are as follows:

CARBON DIOXIDE

CONCENTRATION SYMPTOMS OF EXPOSURE

1%:	Slight increase in breathing rate.
2%:	Breathing rate increases to 50% above normal; exposure cause headache, tiredness.
3%:	Breathing increases to twice normal rate and becomes labored. Weak narcotic effect. Impaired hearing, headache, increase in blood pressure and pulse rate.
4-5%:	Breathing increases to approximately four times normal rate, symptoms of intoxication become evident and slight choking may be felt.
5-10%:	Characteristic sharp odor noticeable. Very labored breathing, headache, visual impairment and ringing in the ears. Judgment may be impaired, followed by loss of consciousness.
>10%:	Unconsciousness occurs more rapidly above 10% level. Prolonged exposure to high concentrations may eventually result in death from asphyxiation.

In addition, high concentrations of this gas mixture can cause an oxygen-deficient environment, especially if released in a poorly-ventilated area (e.g., an enclosed or confined space). Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of overexposure, death may occur. The effects associated with various levels of oxygen are as follows:

OXYGEN

OBSERVED EFFECT

CONCENTRATION

12-16% Oxygen:	Breathing and pulse rate increase, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

CONTACT WITH SKIN or EYES: Contact with this gas mixture and the eyes can result in moderate to severe irritation or burns, depending on the length of contact. Contact with the skin, especially in the presence of moisture and/or if prolonged exposure may result in severe irritation and burns. Repeated low-level skin contact may cause dermatitis (dry, red, itchy skin). Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite.

SKIN ABSORPTION: Skin absorption is a significant route of exposure for Nitric Oxide following prolonged low-level exposure.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: Over-exposure to this gas mixture may cause the following health effects:

ACUTE: This gas mixture can produce adverse health effects due to Carbon Dioxide, Carbon Monoxide and Nitric Oxide overexposure or oxygen deficiency. Due to presence of Nitric Oxide, inhalation may include moderate to severe irritation to respiratory system and delayed pulmonary edema and chemical pneumonitis. Symptoms of overexposure, to Carbon Monoxide at concentrations present in this gas mixture, may include lips and fingernails turning bright red, headaches, shortness of breath, wheezing, blurred vision, memory loss, dizziness, indigestion, and nausea. Severe inhalation overexposures can be fatal. Symptoms of oxygen deficiency include ringing in ears, headaches, shortness of breath, wheezing, dizziness, indigestion, and nausea. At high concentrations, unconsciousness or death may occur. Skin and eye contact may cause moderate to severe irritation or burns.

CHRONIC: Chronic skin exposure may cause dermatitis. Chronic inhalation exposure may result in respiratory disorders. Reversible effects on the acid-base balance in the blood, blood pressure, and circulatory system may occur after prolonged exposure to elevated Carbon Dioxide levels. Carbon Monoxide is a reproductive toxin. Refer to Section 11 (Toxicological Information) of this MSDS for further information.

TARGET ORGANS: ACUTE: Respiratory system, skin, eyes. CHRONIC: Reproductive system, skin.

HMIS RATING: HEALTH HAZARD = 3 FLAMMABILITY HAZARD = 0 PHYSICAL HAZARD = 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

4. FIRST-AID MEASURES

GENERAL INFORMATION: Remove to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. **Seek medical attention immediately.**

INHALATION EXPOSURE: Do not allow victim(s) to exert themselves. Trained person should give oxygen as soon as possible. Keep victim warm and quiet until medical attention is possible.

SKIN EXPOSURE: Rinse exposed skin for at least 15 minutes under running water. Remove contamination clothing. If release of this gas mixture has resulted in frostbite, warm affected area slowly. Seek immediate medical attention.

EYE EXPOSURE: If release of this gas mixture has affected the eyes, seek immediate medical attention. Rinse eyes for at least 15 minutes under running water. Have victim roll eyes.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by overexposure to this gas mixture.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen as soon as possible, following exposure. 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 Nitric Oxide contaminates the eye, use an optic anesthetic to reduce pain. The victim should be promptly examined by an ophthalmologist.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

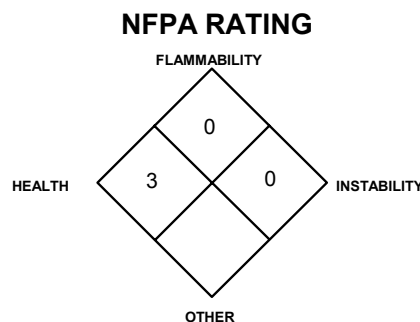
FIRE EXTINGUISHING MATERIALS: Use extinguishing materials appropriate for surrounding materials involved in the fire. Water spray should be used to cool fire-exposed containers.

UNUSUAL FIRE AND EXPLOSION HAZARD: This gas mixture does not burn; however, cylinders, when involved in a 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.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Immediately cool the cylinders with water spray from a maximum distance. When cool, move cylinders from fire area if this can be done without risk to firefighters.



**See Section 16 for
Definition of Ratings**

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used in the event of a significant release from a single cylinder. Call CHEMTREC (1-800-424-9300) for emergency assistance. Or if in Canada, call CANUTEC (613-996-6666).

Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there. Monitor the surrounding area for the level of Carbon Dioxide, Carbon Monoxide and Oxygen. The atmosphere must have at least 19.5 percent Oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES

Do not eat or drink while handling chemicals.

Be aware of all potential exposure symptoms; exposures to a fatal oxygen-deficient atmosphere 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.

Workers who handle this gas mixture should wear protective clothing, as listed in Section 8 (Exposure Controls and Personal Protection).

If ventilation controls are not adequate to provide sufficient oxygen content, proper respiratory protection equipment should be provided and workers using such equipment should be carefully trained in its operation and limitations.

Precautions must always be taken to prevent suck-back of foreign materials into the cylinder by using a check-valve, or vacuum break, since suck-back may cause dangerous pressure changes within the cylinder.

STORAGE AND HANDLING PRACTICES: Cylinders should be stored upright and be firmly secured to prevent falling or being knocked-over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Cylinders should be stored in dry, well-ventilated areas away from sources of heat or ignition. Do not allow area where cylinders are stored to exceed 52°C (125°F).

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Compressed gases can present significant safety hazards. The following rules are applicable to work situations in which cylinders are being used.

Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap (where provided) in-place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not use oils or grease on gas-handling fittings or equipment. Immediately contact the supplier if there are any difficulties associated with operating the cylinder valve. Never insert an object (e.g wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage the valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc, on a compressed gas cylinder or make a cylinder part of an electric circuit.

After Use: Close main cylinder valve. Replace valve protection cap. Close valve after each use and when empty. Mark empty cylinders "EMPTY".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Refer to current CGA Guidelines for information on protective practices during maintenance of contaminated equipment.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure compliance with exposure limits described in Section 2 (Composition and Information on Ingredients). Local exhaust ventilation is preferred, because it prevents dispersion of this gas mixture into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of Oxygen.

RESPIRATORY PROTECTION: Maintain the Oxygen level above 19.5% in the workplace. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards and Canadian CSA Standard Z94.4-93. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998). The following are NIOSH respiratory protection guidelines for the Carbon Dioxide, Carbon Monoxide and Nitric Oxide components of this gas mixture:

CARBON DIOXIDE CONCENTRATION

Up to 40,000 ppm:

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.

Escape:

RESPIRATORY PROTECTION

Any Supplied-Air Respirator (SAR), or any Self-Contained Breathing Apparatus (SCBA) with a full facepiece.

Any appropriate escape-type, SCBA.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued):

CARBON MONOXIDE

CONCENTRATION

Up to 350 ppm:

Up to 875 ppm:

Up to 1200 ppm:

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 carbon monoxide; or escape-type SCBA.

NITRIC OXIDE

CONCENTRATION

Up to 100 ppm:

RESPIRATORY EQUIPMENT

Supplied Air Respirator (SAR).

SAR operated in a continuous flow mode.

Gas mask with canister to protect against carbon monoxide; or full-facepiece Self-Contained Breathing Apparatus (SCBA); or full-facepiece SAR.

RESPIRATORY EQUIPMENT

Any Supplied-Air Respirator (SAR) operated in a continuous-flow mode, or any Chemical Cartridge Respirator with a full facepiece and cartridge(s) providing protection against Nitric Oxide. Only non-oxidizable sorbents are allowed (not charcoal), or any Powered, Air-Purifying Respirator (PAPR) with cartridge(s) providing protection against Nitric Oxide, or any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against Nitric Oxide, or any SAR, or Self-Contained Breathing Apparatus (SCBA) with a full facepiece.

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.

Escape: Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against Nitric Oxide. Only non-oxidizable sorbents are allowed (not charcoal), or any appropriate escape-type, SCBA.

EYE PROTECTION: Splash goggles or safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133, or appropriate Canadian Standards.

HAND PROTECTION: Wear mechanically-resistant gloves when handling cylinders containing this gas mixture. If necessary, refer to U.S. OSHA 29 CFR 1910.138, or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to the task. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet, foot protection should be used, as described in U.S. OSHA 29 CFR 1910.136.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is pertinent for Carbon Dioxide, a main component of this gas mixture.

GAS DENSITY @ 21°C (70°F) and 1 atm: 0.1144 lb/ft³ (1.833 kg/m³)

SPECIFIC GRAVITY (gas) @ 21°C (70°F): 1.52 **EVAPORATION RATE (nBuAc = 1):** Not applicable

VAPOR PRESSURE (psig): 830

SPECIFIC VOLUME (ft³/lb): 8.8

SOLUBILITY IN WATER @ 20°C (68°F): 0.90%

ODOR THRESHOLD: Not applicable.

EXPANSION RATIO: Not applicable.

pH @ 1 atm: 3.7 (carbonic acid)

BOILING POINT @ 1 atm (sublimation point): -78.5°C (-109.3°F)

TRIPLE POINT @ 60.4 psig (416 kPa): -56.6°C (-69.9°F)

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable

9. PHYSICAL and CHEMICAL PROPERTIES (Continued)

The following information is pertinent for Nitrogen, the main component of this gas mixture:

VAPOR DENSITY: 1.145 kg/m ³ (0.0715 lb/ft ³)	EVAPORATION RATE (nBuAc = 1): Not applicable.
SPECIFIC GRAVITY (air = 1): 0.967	FREEZING POINT: -210°C (-345.8°F)
SOLUBILITY IN WATER: 1.49% (v/v)	BOILING POINT (@ 1 atmos.): -195.8°C (-320.4°F)
EXPANSION RATIO: Not applicable.	SPECIFIC VOLUME (ft³/lb): 13.8
ODOR THRESHOLD: Not applicable.	VAPOR PRESSURE (psia): Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.	

The following information is pertinent to this product:

APPEARANCE, ODOR AND COLOR: This gas mixture is colorless with an irritating odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no distinct warning properties of this gas mixture. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Stable at standard temperatures and pressures.

DECOMPOSITION PRODUCTS: The Nitric Oxide component oxidizes in air to form Nitrogen Dioxide. In contact with water or moisture and oxygen, Nitric Oxide forms nitrous and nitric acids. The remaining components of this product do not decompose, per se, but may react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Atmospheres containing high levels of the Carbon Dioxide component of this gas mixture will ignite and explode when heated with powdered aluminum, beryllium, cerium alloys, chromium, magnesium-aluminum alloys, manganese, thorium, titanium, and zirconium. In the presence of moisture, Carbon Dioxide will ignite with cesium oxide. Metal acetylides will also ignite and explode on contact with Carbon Dioxide. Carbon Monoxide is incompatible with acrolein, aziridine, magnesium, titanium, zirconium, sodium peroxide, powders of aluminum, magnesium and tin, diethyl magnesium, cesium oxide, monolithium acetylide-ammonia, rubidium acetylides, lithium, sodium and metal hydrides. The Nitric Oxide component is incompatible with oxygenating agents, halides, hydrocarbons and oxygen. In the presence of moisture, Nitric Oxide can react with fluorine, fluorine oxides and chlorine. Nitrogen, the main component, is a relatively inert gas.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Nitrogen is a simple asphyxiant (SA), which acts to displace oxygen in the environment. The toxicological data for Oxygen are related to exposures at high concentrations and elevated pressures (and are not pertinent to the type of exposures associated with this gas mixture). The following are toxicity data for the Carbon Dioxide, Carbon Monoxide and Nitric Oxide components of this gas mixture:

CARBON DIOXIDE:

LCLo (Inhalation-Human) 9 pph/5 minutes

LCLo (Inhalation-Mammal-species unspecified) 90000 ppm/5 minutes

TCLo (Inhalation-Rabbit) 27,000 ppm/24 hours/30 days-continuous: Behavioral: somnolence (general depressed activity)

TCLo (Inhalation-Rat) 6 pph/24 hours: female 10 day(s) after conception: Reproductive: Specific Developmental Abnormalities: musculoskeletal system, cardiovascular (circulatory) system, respiratory system

TCLo (Inhalation-Rat) 6 pph/24 hours: female 10 day(s) after conception: Reproductive: Effects on Newborn: growth statistics (e.g.%, reduced weight gain)

TCLo (Inhalation-Rabbit) 13 pph/4 hours: female 9-12 day(s) after conception: Reproductive: Specific Developmental Abnormalities: musculoskeletal system

TCLo (Inhalation-Rat) 10000 ppm/24 hours/days-continuous: Blood: other changes

TCLo (Inhalation-Mouse) 55 pph/2 hours: male 3 day(s) pre-mating: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count)

TCLo (Inhalation-Mouse) 55 pph/4 hours: male 6 day(s) pre-mating: Reproductive: Fertility: male fertility index (e.g. # males impregnating females per # males exposed to fertile non-pregnant females)

CARBON MONOXIDE:

LC₅₀ (Inhalation-Rat) 1807 ppm/ 4 hour s

LC₅₀ (Inhalation-Mouse) 2444 ppm/ 4 hours

TCLo (Inhalation-Human) 600 mg/m³/ 10 minutes

TCLo (Inhalation-Man) 650 ppm/45 minutes: Central nervous system, Blood effects

TCLo (Inhalation-Mouse) 65 ppm/ 24 hours (female 7-18 days post): Reproductive effects

TCLo (Inhalation-Mouse): 8 pph/ 1 hours (female 8 days post): Teratogenic effects

LCLo (Inhalation-Man) 4000 ppm/ 30 minutes

LCLo (Inhalation-Human) 5000 ppm/ 5 minutes

(continued on following page)

11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):

NITRIC OXIDE:

LC₅₀ (Inhalation-Rat) 1068 mg/m³/4 hours
 LCLo (Inhalation-Mouse) 320 ppm: Behavioral: convulsions or effect on seizure threshold; Lungs, Thorax, or Respiration: cyanosis; Blood: methemoglobinemia-carboxyhemoglobin
 LCLo (Inhalation-Dog) 5000 ppm/25 minutes: Lungs, Thorax, or Respiration: acute pulmonary edema; Blood: methemoglobinemia-carboxyhemoglobin
 TCLo (Inhalation-Rat) 200 ppm/6 hours/7 days-intermittent: Lungs, Thorax, or Respiration: acute pulmonary edema; Blood: methemoglobinemia-carboxyhemoglobin
 TCLo (Inhalation-Rat) 50 mg/m³/6 hours/7 weeks-intermittent: Lungs, Thorax, or Respiration: changes in lung weight; Liver: changes in liver weight; Nutritional and Gross Metabolic: weight loss or decreased weight gain

NITRIC OXIDE (continued):

TCLo (Inhalation-Rat) 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
 TCLo (Inhalation-Rat) 160 ppm/6 hours/4 weeks-intermittent: Blood: methemoglobinemia-carboxyhemoglobin
 TCLo (Inhalation-Mouse) 10 ppm/2 hours/30 weeks-intermittent: Lungs, Thorax, or Respiration: emphysema; Blood: pigmented or nucleated red blood cells, changes in leukocyte (WBC) count
 Mutation in Microorganisms (Bacteria-Salmonella typhimurium) 30 ppm
 Mutation in Mammalian Somatic Cells (Inhalation-Rat) 27 ppm/3 hours-continuous
 Mutation in Mammalian Somatic Cells (Hamster-Fibroblast) 10 ppm

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, IARC, NTP, CAL/OSHA, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: This gas mixture is moderately to severely irritating to contaminated tissue, depending on concentration of Nitric Oxide.

SENSITIZATION TO THE PRODUCT: The components of this product not known to be skin or respiratory sensitizers.

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

Mutagenicity: The components of this gas mixture are not reported to cause mutagenic effects in humans. Animal mutagenic data are available for the Carbon Monoxide and Nitric Oxide components of this gas mixture; these data were obtained during clinical studies on specific animal tissues exposed to relatively high doses of this gas.

Embryotoxicity: The components of this gas mixture are not reported to cause embryotoxic effects in humans. Animal mutagenic data are also available for the Carbon Monoxide component of this gas mixture; these data were obtained during clinical studies on specific animal tissues exposed to relatively high doses of this gas.

Teratogenicity: This gas mixture contains a component that can cause teratogenic effects in humans. Studies on test animals exposed to relatively high doses of the Carbon Dioxide components indicate teratogenic effects.

Reproductive Toxicity: The components of this gas mixture are not reported to cause adverse reproductive effects in humans. Studies involving test animals exposed to high concentrations of Carbon Dioxide indicate reproductive effects (e.g. changes in testes).

BIOLOGICAL EXPOSURE INDICES (BEIs): There are Biological Exposure Indices (BEIs) determined for the components of this gas mixture, as follows.

CHEMICAL DETERMINANT	SAMPLING TIME	BEI
Nitric Oxide (as a Methemoglobin Inducer) • Methemoglobin in Blood	• During End of Shift	• 1.5% Hemoglobin
CARBON MONOXIDE • Carboxyhemoglobin in blood • Carbon monoxide in end-exhaled air	• End of shift • End of shift	• 3.5% of hemoglobin • 20 ppm

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas mixture will be dissipated rapidly in well-ventilated areas. Additional environmental data for the components of gas mixture are available as follows:

CARBON DIOXIDE:

The extensive sets of global CO₂ measurements of the National Oceanic and Atmospheric Admin (NOAA) Geophysical Monitoring for Climatic Change (GMCC) division and of the Upper Atmosphere and Space Research Laboratory of Tohoku University are combined with a two-dimensional transport model to derive, in an "inverse" calculation, the latitudinal and seasonal distributions of sources and sinks of CO₂ necessary to reproduce the observed concentration. It is found that the southern oceans are a sink of carbon of 0.8 to 1.5 Gt/yr (1 Gt = 1 x 10¹⁵ g) and that the equatorial areas are a source to the atmosphere of 1.4 to 2.8 Gt. There seems to be significant seasonality in the sources and sinks of CO₂, both in the tropics and in the southern oceans. Seasonal net ecosystem production north of 25 deg N is found to be 6.2 to 8.2 Gt of carbon. The global average net source of atmospheric CO₂ estimated from the Tohoku data is 2.84 Gt C/yr, while for the GMCC data it is 2.98 Gt C/year.

CARBON MONOXIDE:

Atmospheric Fate: A photochemical model was used to quantify the sensitivity of the tropospheric oxidants ozone (O₃) and OH to changes in methane (CH₄), Carbon Monoxide (CO), and NO emissions and to perturbations in climate and stratospheric chemistry. In most cases, increased CH₄ and CO emissions will suppress OH (negative coefficients) in increased O₃ (positive coefficients) except in areas where NO and O₃ influenced by pollution are sufficient to increased OH. In most regions, NO, CO, and CH₄ emission increased will suppress OH and increased O₃, but these trends may be opposed by stratospheric O₃ depletion and climate change.

NITRIC OXIDE:

Complex reactions of Nitric Oxide occur in the atmosphere which contribute to air pollution.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments, respiratory system damage, and damage to the skin and eyes. Because of Nitric Oxide produces corrosive nitrogen dioxide, upon contact with air or moisture, plants may be damaged or destroyed.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Nitric Oxide hydrolyzes to nitrogen dioxide when in contact with water. If a release of this product occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life.

The following are aquatic toxicity data for some components of this gas mixture:

CARBON MONOXIDE:

LD (sunfish) = 1.5 ppm/1-6 hours, fresh water.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Matheson Tri-Gas. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s.
(Nitrogen, Nitric Oxide, Carbon Dioxide, Carbon Monoxide)

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

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Class 2.2 (Non-Flammable Gas)

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as a Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles present serious safety hazards and should be discouraged.

NOTE: Shipment of compressed gas cylinders which have not been filled with the owner's consent is a violation of Federal law (49 CFR, Part 173.301 (b)).

14. TRANSPORTATION INFORMATION (Continued)

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas mixture is considered as dangerous goods, per regulations of Transport Canada.

PROPER SHIPPING NAME: Compressed gases, n.o.s.
(Nitrogen, Nitric Oxide, Carbon Dioxide, Carbon Monoxide)

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

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Not Applicable

HAZARD LABEL: Class 2.2 (Non-Flammable Gas)

SPECIAL PROVISIONS: None

EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.12

ERAP INDEX: None

PASSENGER CARRYING SHIP INDEX: None

PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX:
75

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

NOTE: Shipment of compressed gas cylinders via Public Passenger Road Vehicle is a violation of Canadian law (Transport Canada Transportation of Dangerous Goods Act, 1992).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: No components of this product are subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Nitric Oxide	Yes	Yes	Yes

U.S. SARA SECTION 302 EXTREMELY HAZARD THRESHOLD PLANNING QUANTITY (TPQ): Nitric Oxide = 100 lb (45.4 kg)

U.S. SARA SECTION 304 EXTREMELY HAZARD REPORTABLE QUANTITY (RQ): Nitric Oxide = 10 lb (4.5 kg)

U.S. CERCLA REPORTABLE QUANTITY (RQ): Nitric Oxide = 10 lb (4.5 kg)

U.S. SARA HAZARD CATEGORIES (SECTION 311/312, 40 CFR 370-21): ACUTE: Yes; CHRONIC: Yes; FIRE: No; REACTIVE: No; SUDDEN RELEASE: Yes

U.S. TSCA INVENTORY STATUS: Components of this product are listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Under the Clean Air Act, 1129 (r) the Nitric Oxide component of this gas mixture has a Threshold Quantity of 10,000 lb (4540 kg)

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): The Carbon Monoxide is on the California Proposition List as a compound that causes reproductive toxicity. WARNING! This product contains a compound known to the State of California to cause reproductive harm.

LABELING: If cylinders of this gas mixture should be labeled for precautionary information per the guidelines of the CGA. Refer to the CGA for further information.

ADDITIONAL CANADIAN REGULATIONS:

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

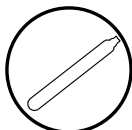
OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: The components of this product are not on the CEPA Priorities Substances Lists.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS (continued):

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This gas mixture would be categorized as a Controlled Product, Hazard Classes: **A** (compressed gas), and **D1A** (Materials Causing Immediate and Serious Toxic Effect- Acute and Chronic Toxic Effects). The following symbols are required for WHMIS compliance for this gas mixture.



16. OTHER INFORMATION

CREATION DATE: August 20, 2004

REVISION DATE: New

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you use the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 421 Walney Road, 5th Floor, Chantilly, VA 20151. Telephone: (703) 788-2700, Fax: (703) 961-1831.

"Safe Handling of Compressed Gases in Containers" (P-1, 1999)

"Safe Handling and Storage of Compressed Gases" (AV-1, 1999)

"Handbook of Compressed Gases" (2000)

16. OTHER INFORMATION (Continued)

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
800/441-3365

DEFINITIONS OF TERMS (Continued)

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 that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELs: NIOSH's Recommended Exposure Limits.

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. 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 that was vacated by Court Order.

SKIN: Used when there is a danger of cutaneous absorption.

EXPOSURE LIMITS IN AIR (continued):

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that 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.

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

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.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HAZARD RATINGS: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD:

0 (Minimal Hazard): No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation:* Essentially non-irritating. PII or Draize = "0". *Eye Irritation:* Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD₅₀ Rat:* < 5000 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit:* < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC₅₀ Rat:* < 20 mg/L.);

16. OTHER INFORMATION (Continued)

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

HEALTH HAZARD (continued):

1 (Slight Hazard: Minor reversible injury may occur; slightly or mildly irritating. *Skin Irritation*: Slightly or mildly irritating. *Eye Irritation*: Slightly or mildly irritating. *Oral Toxicity LD₅₀ Rat*: > 500-5000 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit*: > 1000-2000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat*: > 2-20 mg/L); **2** (Moderate Hazard: Temporary or transitory injury may occur. *Skin Irritation*: Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation*: Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat*: > 50-500 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit*: > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat*: > 0.5-2 mg/L.); **3** (Serious Hazard: Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation*: Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation*: Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD₅₀ Rat*: > 1-50 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit*: > 20-200 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat*: > 0.05-0.5 mg/L.); **4** (Severe Hazard: Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation*: Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation*: Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD₅₀ Rat*: ≤ 1 mg/kg. *Dermal Toxicity LD₅₀Rat or Rabbit*: ≤ 20 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat*: ≤ 0.05 mg/L).

FLAMMABILITY HAZARD:

0 (Minimal Hazard-Materials that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.); **1** (Slight Hazard-Materials that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur, including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]); **2** (Moderate Hazard-Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, including: Liquids having a flash-point at or above 37.8°C [100°F]; Solid materials in the form of coarse dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.); **3** (Serious Hazard- Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]);

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued):

4 (Severe Hazard-Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric]).

PHYSICAL HAZARD:

0 (*Water Reactivity*: Materials that do not react with water. *Organic Peroxides*: Materials that are normally stable, even under fire conditions and will not react with water. *Explosives*: Substances that are Non-Explosive. *Unstable Compressed Gases*: No Rating. *Pyrophorics*: No Rating. *Oxidizers*: No "0" rating allowed. *Unstable Reactives*: Substances that will not polymerize, decompose, condense or self-react.); **1** (*Water Reactivity*: Materials that change or decompose upon exposure to moisture. *Organic Peroxides*: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives*: Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases*: Pressure below OSHA definition. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group III; *Solids*: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. *Liquids*: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives*: Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.); **2** (*Water Reactivity*: Materials that may react violently with water. *Organic Peroxides*: Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives*: Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases*: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group II *Solids*: any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. *Liquids*: any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%)/cellulose mixture and the criteria for Packing Group I are not met. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature);

16. OTHER INFORMATION (Continued)

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

3 (continued): *Oxidizers:* Packing Group I *Solids:* any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. *Liquids:* Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%)/cellulose mixture. *Unstable Reactives:* Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4** (*Water Reactivity:* Materials that react explosively with water without requiring heat or confinement. *Organic Peroxides:* Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. *Explosives:* Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. *Compressed Gases:* No Rating. *Pyrophorics:* Add to the definition of Flammability "4". *Oxidizers:* No "4" rating. *Unstable Reactives:* Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.).

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

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: **0** Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily. **3** (*Water Reactivity:* Materials that may form explosive reactions with water. *Organic Peroxides:* Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. *Explosives:* Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. *Compressed Gases:* Pressure \geq 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics:* No Rating.

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

INSTABILITY HAZARD: **0** Materials that in themselves are normally stable, even under fire conditions. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures. **3** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.

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:

Human and Animal Toxicology: 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. Other measures of toxicity include **TDL_o**, the lowest dose to cause a symptom and **TCL_o** 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. **Cancer Information:** 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 Information:** **BEI** - ACGIH 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:

BCF = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter; **EC** is the Effect Concentration in water; **EC₅₀** is the Effect Concentration for 50% of the organisms exposed; **NOEC** is the No Observed Effect Concentration; **MATC** is the Maximum Acceptable Toxicant Concentration; **NOLC** is the No Observed Lethal Concentration; **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

16. OTHER INFORMATION (Continued)

DEFINITIONS OF TERMS (Continued)

REGULATORY INFORMATION:

U.S. and CANADA:

ACGIH: American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **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**). **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. **OSHA** - U.S. Occupational Safety and Health Administration.