



**MATHESON
TRI•GAS**

ask. .The Gas Professionals™

MATERIAL SAFETY DATA SHEET

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

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS:

NITROGEN DIOXIDE/AIR GAS MIXTURE

CHEMICAL FAMILY: Inorganic Gas Mixture

PRODUCT USE: EPA Protocol Mixture

MANUFACTURER

MATHESON TRI-GAS, INC.

150 ALLEN ROAD, Ste 302
BASKING RIDGE, NJ 07920
USA

Phone: 973/257-1100

EMERGENCY PHONE:

CHEMTREC (U.S. DOMESTIC): 1-800-424-9300

CHEMTREC INTERNATIONAL: 1-703-527-3887

CANUTEC (CANADA): 1-613-996-6666

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-2004 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.

2. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Product Description: This gas mixture is colorless and has a pungent, suffocating odor (due to the presence of Nitrogen Dioxide). **Health Hazards:** The Nitrogen Dioxide component of this gas mixture is toxic at levels possible in this mixture. Exposures to this gas mixture may result in severe irritation and burns of eyes, skin, mucous membranes, and any other exposed tissue. Delayed pulmonary damage and breathing difficulty may occur. Severe over-exposures can be fatal. **Flammability Hazards:** This gas mixture is not flammable. **Reactivity Hazards:** This gas mixture is not reactive. **Environmental Hazards:** Release of this gas mixture may cause hazard to plants and animals in the environment if accidentally released to due to toxicity and the hazard of frostbite in event of rapid release from the cylinder. **Emergency Response Considerations:** Emergency responders must wear appropriate personal protective equipment for the situation to which they are responding.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this gas mixture is by inhalation.

INHALATION: The Nitrogen Dioxide component of this gas mixture is toxic. Inhalation over-exposures to this gas mixture may result in severe irritation and burns of eyes, skin, mucous membranes, and any other exposed tissue. Delayed pulmonary damage and breathing difficulty may also occur. Severe inhalation over-exposures can be fatal. All of the symptoms described above may be aggravated by physical exertion. Based on animal information an increased sensitivity to allergens and bacterial infections may occur as a result of inhalation exposure to Nitrogen Dioxide.

As a result of severe over-exposures to this gas mixture, permanent lung injury may occur. Prolonged or repeated over-exposures to this gas mixture may cause impaired lung function, bronchitis, hacking cough, nasal irritation and discharge, increased fatigue, decreased immune response and dental erosion.

Note: symptoms can develop after over-exposure to concentrations of Nitrogen Dioxide in ranges which exist in this gas mixture. The onset of the symptoms of pulmonary edema can be delayed for hours or days after the exposure.

CONTACT WITH SKIN or EYES: The gas mixture may be irritating to the skin or cause burns in the presence of moisture due to formation of nitric acid and nitrous acid. Symptoms of skin over-exposure may include scratchiness, pain, and redness and burns. If this gas mixture contaminates the eyes, severe injury and swelling of the eye tissue may occur. Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite.

SKIN ABSORPTION: No component of this product is known to be absorbed through intact skin.

2. HAZARD IDENTIFICATION (Continued)

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

ACUTE: Over-exposures may result in severe irritation and burns of eyes, skin, mucous membranes, and any other exposed tissue. If high concentrations of this gas mixture are inhaled, delayed pulmonary damage and breathing difficulty may occur. Severe inhalation over-exposures can be fatal, as a result of lung damage.

CHRONIC: Prolonged or repeated over-exposures to this gas mixture may cause impaired lung function, bronchitis, coughing, nasal irritation and discharge, increased fatigue, decreased immune system response, and dental erosion. Refer to Section 11 (Toxicology Information) for additional data.

TARGET ORGANS: ACUTE: Respiratory system, skin, eyes. CHRONIC: Skin, respiratory system, immune system.

HMIS RATING: HEALTH = 3 FLAMMABILITY = 0 REACTIVITY = 0

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

3. COMPOSITION and INFORMATION ON INGREDIENTS

(10,000 ppm = 1%)

CHEMICAL NAME	CAS #	mole %
Nitrogen Dioxide	10102-44-0	< 2.3%
Air	132259-10-0	Balance

4. FIRST-AID MEASURES

GENERAL INFORMATION: In cases of over exposure, delayed onset of life-threatening symptoms may occur. 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.**

SKIN EXPOSURE: If this gas mixture has contaminated the skin, immediately begin decontamination with running water. Minimum flushing is for 20 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Seek immediate medical attention if adverse effect continued after flushing.

EYE EXPOSURE: If this gas enters the eyes, open exposed eyes while under gentle running water. Use sufficient force to open eyelids. "Roll" eyes. Minimum flushing is for 20 minutes. Seek immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions, skin conditions, or eye disorders may be aggravated by over-exposure to the components of this gas mixture.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen. Treat symptoms and eliminate overexposure.

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.

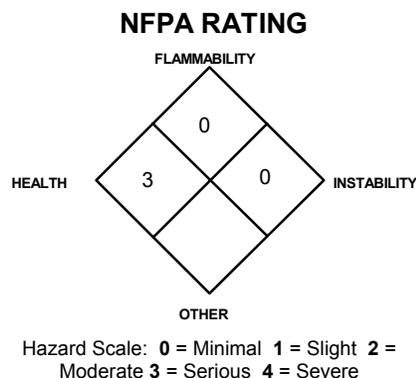
FIRE EXTINGUISHING MATERIALS: Use extinguishing materials appropriate for surrounding materials involved in the fire. Water spray should be used to cool fire-exposed containers.

FIRE EXTINGUISHING MATERIALS NOT TO BE USED: None known.

UNUSUAL FIRE AND EXPLOSION HAZARDS: The Nitrogen Dioxide component of this gas mixture is toxic at relatively low concentrations and presents a significant health hazard to firefighters in the concentrations present in this gas mixture. This component can slowly react with water to form a solution which is corrosive to skin and metal. Corrosive and toxic gases, vapors, and mists may spread from the point of release.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not sensitive.



5. FIRE-FIGHTING MEASURES (Continued)

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural fire fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Use a water spray or fog to reduce or direct vapors. Do not direct a water spray at the source of a release. Water spray should be used with care. Approach fire from an upwind direction, to prevent over-exposure to this gas mixture. If this product is involved in a fire, fire run-off water should be contained to prevent possible environmental damage.

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 presence of Nitrogen Dioxide, and oxygen. The level of Nitrogen Dioxide must be below those listed in Section 8 (Exposure Controls and Personal Protection) and 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 fatal concentrations of this product 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).

Instant-acting showers should be available in the event of an emergency.

Eye-wash fountains or similar equipment should be available for eye irrigation.

If ventilation controls are not adequate to control exposure to this gas mixture, 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 this section. Local exhaust ventilation is preferred, because it prevents dispersion of this gas mixture into the work place by eliminating it at its source.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

VENTILATION AND ENGINEERING CONTROLS (continued): If appropriate, install automatic monitoring equipment to detect the level of Nitrogen Dioxide, and Oxygen. Eye wash stations/safety showers should be near areas where this product is used or stored.

EXPOSURE LIMITS:

(10,000 ppm = 1%)

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR							
		ACGIH-TLVs		OSHA-STELs		NIOSH-RELS		NIOSH	OTHER
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	
Nitrogen Dioxide	10102-44-0	3	5	NE	5 (ceiling) 1 (1989 Vacated PEL)	NE	1	20	Carcinogen: ACGIH TLV-A4, MAK-3B
Air (compressed, atmospheric)	132259-10-0	Compressed air is a mixture of approximately 79% Nitrogen, approximately 21% Oxygen and other trace gases. No exposure limits are applicable to Air, Nitrogen or Oxygen.							

See Section 16 for Definitions of Terms Used.

RESPIRATORY PROTECTION: Maintain the level of Nitrogen Dioxide below those listed in this section and oxygen levels 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 NIOSH respiratory protection recommendations for Nitrogen Dioxide are given for additional information on respiratory protective equipment.

NITROGEN DIOXIDE CONCENTRATION

Up to 20 ppm:

RESPIRATORY PROTECTION

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

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: Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister (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 and the Canadian CSA Standard Z94.3-M1982, *Industrial Eye and Face Protectors*.

HAND PROTECTION: Chemically resistant gloves should be worn when using this gas mixture. 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 necessary, refer to the OSHA Technical Manual (Section VII: Personal Protective Equipment) or appropriate Standards of Canada. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR 1910.136 and the Canadian CSA Standard Z195-02, *Protective Footwear*.

9. PHYSICAL and CHEMICAL PROPERTIES

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

GAS DENSITY: 0.07493 lb/cu ft (1.2 kg/m³)

SPECIFIC GRAVITY (air = 1): 1

SOLUBILITY IN WATER: 0.0292

EXPANSION RATIO: Not applicable.

MOLECULAR WEIGHT: 28.975

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

EVAPORATION RATE (nBuAc = 1): Not applicable.

FREEZING POINT: -216.2°C (-357.2°F)

BOILING POINT (@ 1 atmos.): -194.3°C (-137.8°F)

SPECIFIC VOLUME (ft³/lb): 13.346

VAPOR PRESSURE (psia): Not applicable.

The following information is pertinent to this product:

APPEARANCE, ODOR AND COLOR: This gas mixture is colorless and has a pungent, suffocating odor.

9. PHYSICAL and CHEMICAL PROPERTIES (Continued)

The following information is pertinent to this product:

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor of this gas mixture can be a reliable warning property for releases of this gas mixture as the TLV is 10 times the magnitude of odor threshold. 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. Area monitoring should be performed using appropriate equipment.

10. STABILITY and REACTIVITY

STABILITY: Stable at standard temperatures and pressures.

DECOMPOSITION PRODUCTS: *Combustion:* nitric oxide and oxygen when heated above 160°C (320°F).

The decomposition is appreciable above 600°C (1112°F). *Hydrolysis:* Will react with water or moist air to form nitric acid and nitrous acid. Nitrous acid then decomposes to nitric acid and nitric oxide, especially with increased temperature.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Nitrogen Dioxide is not compatible with combustible materials (e.g. wood, paper, oil, grease) acetic anhydride, alcohols, ammonia, boron trichloride, calcium, dimethyl sulfoxide, formaldehyde, hydrocarbons (e.g. toluene, hexane, hot cyclohexane), nitrogen trichloride, triethylamine, tetramethyltin, unsaturated hydrocarbons (e.g. propene, 1-butene, 1,3-butadiene) vinyl chloride, aluminum powder, carbon disulfide, halocarbons (e.g. dichloromethane, chloroform, carbon tetrachloride, 1,2-dichloroethane) or nitroaromatics (e.g. nitrobenzene, nitrotoluene), hydrogen, oxygen, carbonyl metals, cyclopentadiene or hydrazine derivatives (e.g. hydrazine, methylhydrazine, 1,1-dimethylhydrazine), pyridene or quinoline, metals (e.g. reduced iron, potassium, pyrophoric manganese, sodium), metal acetylides or carbides (e.g. cesium acetylide, tungsten and ditungsten carbides), magnesium filings, white phosphorus, sulfur. Nitrogen Dioxide is corrosive to copper and its alloys. Nitrogen Dioxide is very corrosive to most metals under wet conditions (greater 10% water), except stainless steels, particularly with high chromium content, and nickel-chromium-iron-molybdenum and nickel-chromium-molybdenum alloys and aluminum.

HAZARDOUS POLYMERIZATION: Will not occur.

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

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following are LC₅₀ inhalation-rat and human data for the components of this gas mixture (which are present at a level greater than 1 mole%). Additional animal data are available for the components, but are not being presented in this MSDS.

NITROGEN DIOXIDE:

LCLo (Inhalation-Human) 200 ppm/1 minutes

TCLo (Inhalation-Human) 200 mg/m³: Lungs, Thorax, or Respiration: cough

TCLo (Inhalation-Human) 0.8 mg/m³/3 years-intermittent: Lungs, Thorax, or Respiration: emphysema, fibrosis (interstitial); Blood: change in clotting factors

TCLo (Inhalation-Human) 90 mg/m³/15 minutes: Sense Organs and Special Senses (Olfaction): change in sensation of smell; Lungs, Thorax, or Respiration: cough; Gastrointestinal: changes in structure or function of salivary glands

TCLo (Inhalation-Human) 14 mg/m³: Sense Organs and Special Senses (Eye); conjunctive irritation

TCLo (Inhalation-Human) 0.5 ppm/2 hours: Sense Organs and Special Senses (Eye): conjunctive irritation; Behavioral: headache; Lungs, Thorax, or Respiration: dyspnea

TCLo (Inhalation-Human) 120 mg/m³: Lungs, Thorax, or Respiration: dyspnea

TCLo (Inhalation-Human) 70 mg/m³: Behavioral: muscle weakness

TCLo (Inhalation-Human) 0.2 mg/m³: Sense Organs and Special Senses (Olfaction): change in sensation of smell; Lungs, Thorax, or Respiration: cough

TCLo (Inhalation-Human) 0.14 mg/m³/5 hours: Sense Organs and Special Senses (Eye): effect, not otherwise specified

TCLo (Inhalation-Human) 0.059 mg/m³/5 minutes: Brain and Coverings: changes in surface EEG

TCLo (Inhalation-Human) 38 mg/m³/2 hours: Blood: methemoglobinemia-carboxyhemoglobin

TCLo (Inhalation-Human) 510 mg/m³/5 minutes: Lungs, Thorax, or Respiration: other changes

TCLo (Inhalation-Human) 950 mg/m³/5minutes: Lungs, Thorax, or Respiration: acute pulmonary edema

TCLo (Inhalation-Human) 1.9 mg/m³/2 hours/3 days-intermittent: Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: dehydrogenases

NITROGEN DIOXIDE (continued):

TCLo (Inhalation-Man) 2 ppm/4 hours: Lungs, Thorax, or Respiration: structural or functional change in trachea or bronchi, other changes

TCLo (Inhalation-Man) 6200 ppb/10 minutes: Lungs, Thorax, or Respiration: changes in pulmonary vascular resistance

TCLo (Inhalation-Man) 90 ppm/40 minutes: Lungs, Thorax, or Respiration: cough, dyspnea, other changes

TCLo (Inhalation-Man) 30 ppm/70 minutes: Sense Organs and Special Senses (Eye): conjunctive irritation; Lungs, Thorax, or Respiration: cough, dyspnea

TCLo (Inhalation-Man) 30 ppm/70 minutes: Lungs, Thorax, or Respiration: sputum

LC₅₀ (Inhalation-Mouse) 1000 ppm/10 minutes: Behavioral: convulsions or effect on seizure threshold, changes in motor activity (specific assay)

LC₅₀ (Inhalation-Mouse) 800 mg/m³/25 minutes

LC₅₀ (Inhalation-Rat) 220 mg/m³/1 hour: Lungs, Thorax, or Respiration: acute pulmonary edema

LC₅₀ (Inhalation-Rat) 310 mg/m³/30 minutes: Lungs, Thorax, or Respiration: acute pulmonary edema

LC₅₀ (Inhalation-Rat) 790 mg/m³/5 minutes: Lungs, Thorax, or Respiration: acute pulmonary edema

LC₅₀ (Inhalation-Rat) 165 mg/m³/4 hours: Lungs, Thorax, or Respiration: other changes

LC₅₀ (Inhalation-Rat) 200 ppm/30 minutes

LC₅₀ (Inhalation-Rat) 88 ppm/4 hours

LC₅₀ (Inhalation-Rat) 4 mg/m³/17 hours: Lungs, Thorax, or Respiration: other changes

LC₅₀ (Inhalation-Rat) 32 mg/m³/2 hours: Lungs, Thorax, or Respiration: ciliary function changes, structural or functional change in trachea or bronchi

LC₅₀ (Inhalation-Rat) 25 mg/m³/2 hours: Sense Organs and Special Senses (Eye): conjunctive irritation Lungs, Thorax, or Respiration: cough

LC₅₀ (Inhalation-Rat) 22.7 mg/m³/4 hours: Brain and Coverings: other degenerative changes; Lungs, Thorax, or Respiration: other changes; Endocrine: other changes

LC₅₀ (Inhalation-Rat) 1.9 mg/m³/4 hours: Lungs, Thorax, or Respiration: other changes

LC₅₀ (Inhalation-Mouse) 900 mg/m³/2 hours

11. TOXICOLOGICAL INFORMATION (Continued)

CARCINOGENIC POTENTIAL OF COMPONENTS: The components of this gas mixture are listed by agencies tracking the carcinogenic potential of chemical compounds, as follows:

NITROGEN DIOXIDE: ACGIH-TLV A4, (Not Classifiable as Human Carcinogen); MAK-3B (Substances for Which *in vitro* Tests or Animal Studies Have Yielded Evidence of Carcinogenic Effects that is Not Sufficient for Classification of the Substance in One of the Other Categories. Further Studies are Required Before a Final Classification Can Be Made.)

The remaining components of this product are not found on the following lists: U.S. EPA, U.S. NTP, U.S. OSHA, U.S. NIOSH, GERMAN MAK, IARC, or ACGIH, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: This product is severely irritating to contaminated tissue.

SENSITIZATION TO THE PRODUCT: The components of this product are 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. Positive results have been obtained in one study using live animals. Positive results have also been obtained in bacteria and cultured mammalian cells. The mutagenic data for Nitrogen Dioxide are, as follows:

Mutation in Microorganisms (Bacteria- <i>Salmonella typhimurium</i>) 6 ppm	Unscheduled DNA Synthesis (Inhalation-Rat) 30 ppm/1 hour
Mutation in Microorganisms (Bacteria- <i>Salmonella typhimurium</i>) 5 ppm	Cytogenetic Analysis (Inhalation-Rat) 27 ppm/3 hours-continuous
Mutation Test Systems-Not Otherwise Specified (Bacteria- <i>Salmonella typhimurium</i>) 50 ppm	Cytogenetic Analysis (Hamster-Fibroblast) 10 ppm/10 minutes-continuous
Mutation Test Systems-Not Otherwise Specified (Bacteria- <i>Escherichia coli</i>) 297 µg/L	Mutation in Mammalian Somatic Cells (Inhalation-Rat) 15 ppm hours-continuous
Mutation in Microorganisms (Bacteria- <i>Escherichia coli</i>) 198 µg/L	DNA Damage (Hamster-Lung) 10 ppm
	Sister Chromatid Exchange (Hamster-Lung) 5 ppm/10 minutes-continuous
	DNA Adduct (Inhalation-Rat) 108 mg/kg/300 days-intermittent

Embryotoxicity: The components of this gas mixture are not reported to cause embryotoxic effects in humans. No conclusions can be drawn from the limited animal information available.

Teratogenicity: This gas mixture contains a component that can cause teratogenic effects in humans.

Reproductive Toxicity: The components of this gas mixture are not reported to cause adverse reproductive effects in humans. The limited animal data available has not demonstrated significant reproductive effects.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, there are no Biological Exposure Indices (BEIs) determined for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

MOBILITY: As a gas mixture, this product does not present a hazard of mobility in the soil. The following information is for the Nitrogen Dioxide component.

NITROGEN DIOXIDE:

Soil Adsorption/Mobility: Nitrogen Dioxide is expected to volatilize from dry soil surfaces based upon its vapor pressure.

PERSISTENCE AND BIODEGRADABILITY: The components of this gas mixture will volatilize and degrade into other organic compounds. The following information is for the Nitrogen Dioxide component.

NITROGEN DIOXIDE:

Persistence and Biodegradability: If released to air, a vapor pressure of 900 mm Hg at 25°C indicates Nitrogen Dioxide will exist solely as a gas in the ambient atmosphere. Gas-phase Nitrogen Dioxide is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with an estimated atmospheric half-life of 35 hours. The reaction of Nitrogen Dioxide with photochemically-produced hydroxyl radicals leads to the formation of nitric acid, which is a major constituent of acid rain. This compound is expected to undergo direct photolysis in the environment, ultimately leading to the production of ozone and smog conditions in the lower troposphere. If released to soil, this compound is expected to decompose to nitric acid in moist soil surfaces. If released into water, Nitrogen Dioxide is expected to decompose to nitric acid.

Bioconcentration: No information is available on bioconcentration of Nitrogen Dioxide.

BIO-ACCUMULATION POTENTIAL: The components of this gas mixture do not present a hazard of bio-accumulation.

ECOTOXICITY: This gas mixture has not been tested for aquatic or animal toxicity. All release to terrestrial, atmospheric and aquatic environments should be avoided.

OTHER ADVERSE EFFECTS: The components of this gas mixture are not listed as having ozone depletion potential.

ENVIRONMENTAL EXPOSURE CONTROLS: Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

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

U.S. DEPARTMENT OF TRANSPORTATION REGULATIONS: This gas mixture is classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

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
PACKING GROUP: Not Applicable
D.O.T HAZARD LABEL: Class 2.2 (Non-Flammable Gas)
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): 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)).

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

PROPER SHIPPING NAME: Compressed gas, n.o.s. (Nitrogen, Nitrogen Dioxide)
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not Applicable
HAZARD LABEL: 2.2 (Non-Flammable Gas)
SPECIAL PROVISIONS: None
EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.125
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 (2004): 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).

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)).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: The 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:

COMPOUND	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Nitrogen Dioxide	YES	YES	NO

U.S. SARA SECTION 302 EXTREMELY HAZARDOUS THRESHOLD PLANNING QUANTITY (TPQ): Nitrogen Dioxide = 100 lb (45.4 kg)

U.S. SARA SECTION 304 EXTREMELY HAZARDOUS REPORTABLE QUANTITY (RQ): Nitrogen Dioxide = 10 lb (4.54 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.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Nitrogen Dioxide is an Extremely Hazardous Substance with a 10 lb (4.45 kg) reporting requirement.

OTHER U.S. FEDERAL REGULATIONS: Nitrogen Dioxide is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The threshold quantity for this gas is 5,000 lbs (2,270 kg).

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this product is on the California Proposition 65 lists.

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.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: The components of this product 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.

CANADIAN WHMIS SYMBOLS: This gas mixture would be categorized as a Controlled Product, Hazard Classes: **A** (compressed gas), **D1A** (Poisonous and Infectious Materials-Immediate and Serious Effects: Very Toxic), **D2A** (Chronic Toxicity: Very Toxic), and **D2B** (Poisonous and Infectious Materials-Immediate and Serious Effects: Materials Causing Other Toxic Effects: Toxic). The following symbols are required for WHMIS compliance for this gas mixture.



16. OTHER INFORMATION

CREATION DATE: May 4, 2001

REVISION DATE: September 11, 2008

REVISION HISTORY: Review and up-date of entire MSDS; up-date to current ANSI Standard.

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" (1992)

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
(800)441-3365 / (619) 441-3365

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 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.

DFG MAK Pregnancy Risk Group Classification: **Group A:** A risk of damage to the developing embryo or fetus has been unequivocally demonstrated. Exposure of pregnant women can lead to damage of the developing organism, even when MAK and BAT (Biological Tolerance Value for Working Materials) values are observed.

DFG MAK Pregnancy Risk Group Classification (continued): **Group B:** Currently available information indicates a risk of damage to the developing embryo or fetus must be considered to be probable. Damage to the developing organism cannot be excluded when pregnant women are exposed, even when MAK and BAT values are observed. **Group C:** There is no reason to fear a risk of damage to the developing embryo or fetus when MAK and BAT values are observed. **Group D:** Classification in one of the groups A-C is not yet possible because, although the data available may indicate a trend, they are not sufficient for final evaluation.

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.

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.

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.

EXPOSURE LIMITS IN AIR (continued):

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.

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 LD₅₀ Rat or Rabbit:** < 2000 mg/kg. **Inhalation Toxicity 4-hrs LC₅₀ Rat:** < 20 mg/L; 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 LD₅₀ Rat 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 LD₅₀ Rat 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 LD₅₀ Rat 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 LD₅₀ Rat or Rabbit:** ≤ 20 mg/kg. **Inhalation Toxicity LC₅₀ 4-hrs Rat:** ≤ 0.05 mg/L).

16. OTHER INFORMATION (Continued)

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

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 IIB, 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 course 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]); **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); **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 ≥ 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating.

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 (materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 10,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 200 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 2000 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 2000 mg/kg. Materials that are essentially non-irritating to the respiratory tract, eyes and skin. **1** (materials that, under emergency conditions, can cause significant irritation): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 5,000 ppm but less than or equal to 10,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 10 mg/L but less than or equal to 200 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 1000 mg/kg but less than or equal to 2000 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 500 mg/kg but less than or equal to 2000 mg/kg. Materials that cause slight to moderate irritation to the respiratory tract, eyes and skin. **2** (materials that, under emergency conditions, can cause temporary incapacitation or residual injury): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 3,000 ppm but less than or equal to 5,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 2 mg/L but less than or equal to 10 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 200 mg/kg but less than or equal to 1000 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 50 mg/kg but less than or equal to 500 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC₅₀ for acute inhalation toxicity, if its LC₅₀ is less than or equal to 5000 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. *Compressed liquefied gases* with boiling points between -30°C (-22°F) and -55°C (-66.5°F) that cause severe tissue damage, depending on duration of exposure. Materials that are respiratory irritants. Materials that cause severe, but reversible irritation to the eyes or are lachrymators. Materials that are primary skin irritants or sensitizers. **3** (materials that, under emergency conditions, can cause serious or permanent injury): Gases and vapors whose LC₅₀ for acute inhalation toxicity is greater than 1,000 ppm but less than or equal to 3,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is greater than 0.5 mg/L but less than or equal to 2 mg/L. Materials whose LD₅₀ for acute dermal toxicity is greater than 40 mg/kg but less than or equal to 200 mg/kg. Materials whose LD₅₀ for acute oral toxicity is greater than 5 mg/kg but less than or equal to 50 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC₅₀ for acute inhalation toxicity, if its LC₅₀ is less than or equal to 3000 ppm and that does not meet the criteria for degree of hazard 4. *Compressed liquefied gases* with boiling points between -30°C (-22°F) and -55°C (-66.5°F) that cause frostbite and irreversible tissue damage. Materials that are respiratory irritants. Cryogenic gases that cause frostbite and irreversible tissue damage. Materials that are corrosive to the respiratory tract. Materials that are corrosive to the eyes or cause irreversible corneal opacity. Materials that are corrosive to the skin. **4** (materials that, under emergency conditions, can be lethal): Gases and vapors whose LC₅₀ for acute inhalation toxicity less than or equal to 1,000 ppm. Dusts and mists whose LC₅₀ for acute inhalation toxicity is less than or equal to 0.5 mg/L. Materials whose LD₅₀ for acute dermal toxicity is less than or equal to 40 mg/kg. Materials whose LD₅₀ for acute oral toxicity is less than or equal to 5 mg/kg. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC₅₀ for acute inhalation toxicity, if its LC₅₀ is less than or equal to 1000 ppm.

FLAMMABILITY HAZARD: 0 Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand: Materials that will not burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D. **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: Materials that will burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with Annex D. Liquids, solids and semisolids having a flash point at or above 93.4°C (200°F) (i.e. Class IIB liquids). Liquids with a flash point greater than 35°C (95°F) that do not sustain combustion when tested using the *Method of Testing for Sustained Combustibility*, per 49 CFR 173, Appendix H or the UN *Recommendation on the Transport of Dangerous Goods, Model Regulations* (current edition) and the related *Manual of Tests and Criteria* (current edition). Liquids with a flash point greater than 35°C (95°F) in a water-miscible solution or dispersion with a water non-combustible liquid/solid content of more than 85 percent by weight. Liquids that have no fire point when tested by ASTM D 92 Standard Test Method for Flash and Fire Points by Cleveland Open Cup, up to a boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change.

16. OTHER INFORMATION (Continued)

DEFINITIONS OF TERMS (Continued)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued): 1 (continued): Combustible pellets with a representative diameter of greater than 2 mm (10 mesh). Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. Most ordinary combustible materials. **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: Liquids having a flash point at or above 37.8°C (100°F) and below 93.4°C (200°F) (i.e. Class II and Class IIIA liquids.) Solid materials in the form of powders or coarse dusts of representative diameter between 420 microns (40 mesh) and 2 mm (10 mesh) that burn rapidly but that generally do not form explosive mixtures in air. Solid materials in fibrous or shredded form that burn rapidly and create flash fire hazards, such as cotton, sisal and hemp. Solids and semisolids that readily give off flammable vapors. Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. **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: Liquids having a flash point below 22.8°C (73°F) and having a boiling point at or above 37.8°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (73°F) and below 37.8°C (100°F) (i.e. Class IB and IC liquids). Materials that, on account of their physical form or environmental conditions, can form explosive mixtures with air and are readily dispersed in air. Flammable or combustible dusts with a representative diameter less than 420 microns (40 mesh). Materials that burn with extreme rapidity, usually by reason of self-contained oxygen (e.g. dry nitrocellulose and many organic peroxides). Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. **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: Flammable gases. Flammable cryogenic materials. Any liquid or gaseous materials 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) (i.e. Class IA liquids). Materials that ignite when exposed to air. Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.

INSTABILITY HAZARD: 0 Materials that in themselves are normally stable, even under fire conditions: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) below 0.01 W/mL. Materials that do not exhibit an exotherm at temperatures less than or equal to 500°C (932°F) when tested by differential scanning calorimetry. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 0.01 W/mL and below 10 W/mL. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 10 W/mL and below 100W/mL. **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: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 100 W/mL and below 1000 W/mL. Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures: Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) of 1000 W/mL or greater. Materials that are sensitive to localized thermal or mechanical shock 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 **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. **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.

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