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**MATERIAL SAFETY DATA SHEET**

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

**1. PRODUCT IDENTIFICATION**

**CHEMICAL NAME; CLASS:** NON-FLAMMABLE GAS MIXTURE

Containing the Following Components in a Nitrogen Balance Gas:

**Nitrogen Dioxide 0.0001-0.022%, Hexane 0.0-0.48%, Pentane 0.0-0.75%, Carbon Monoxide 0.0005-1.0%, Propane 0.0-1.1%, Oxygen 0.0015-23.5%**

**SYNONYMS:** Not Applicable    **CHEMICAL FAMILY NAME:** Not Applicable    **FORMULA:** Not Applicable

**U.N. NUMBER:** UN 1956    **U.N. DANGEROUS GOODS CLASS/SUBSIDIARY RISK:** 2.2 (Non-Flammable Gas)

**Document Number:** 50115(Replaces ISC MSDS No. 1810-6773)

**Note:** The Material Safety Data Sheet is for this gas mixture supplied in both refillable and non-refillable cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 3 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

<b>PRODUCT USE:</b>	Calibration of Monitoring and Research Equipment
<b>U.S. SUPPLIER/MANUFACTURER'S NAME:</b>	CALGAZ
<b>ADDRESS:</b>	821 Chesapeake Drive Cambridge, MD 21613
<b>BUSINESS PHONE:</b>	1-410-228-6400 (need hours phone is manned)
General MSDS Information:	1-713/868-0440
Fax on Demand:	1-800/231-1366
<b>EMERGENCY PHONE:</b>	
Chemtrec: United States/Canada/Puerto Rico:	1-800/424-9300 [24-hours]
Chemtrec International:	01-703-527-3887 [24-hours]

NOTE: ALL Canadian WHMIS required information is included 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 is a colorless to red-brown gas mixture with an acrid, pungent odor.  
**Health Hazards:** This gas mixture may cause adverse health effects due to the presence of Nitrogen Dioxide and Carbon Monoxide, which can reach exposure limits at the percentages in this mixture. Releases of this gas mixture may also produce oxygen-deficient atmospheres (especially in confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated. The Carbon Monoxide component is a human reproductive toxin. Rapidly released gas can cause frostbite.  
**Flammability Hazards:** This gas is non-flammable and will not support combustion. A moderate cylinder rupture hazard exists when this gas mixture, which is under pressure, is subject to heat or flames.  
**Reactivity Hazards:** This gas mixture is not reactive.  
**Environmental Hazards:** Release of this gas mixture is not expected to cause harm to the environment or to plants and animals, except for possible frost and freezing from rapid release of a cylinder.  
**Emergency Response Procedures:** Emergency responders must wear the proper personal protective equipment suitable for the situation to which they are responding.  
**WARNING -** If rescue personnel need to enter an area suspected of having a low level of Oxygen, they should be equipped with Self-Contained Breathing Apparatus (SCBA).

**3. COMPOSITION and INFORMATION ON INGREDIENTS**

Chemical Name	Chemical Formula	CAS #	% Composition
Nitrogen Dioxide	NO <sub>2</sub>	10102-44-0	0.0001-0.022%
Hexane	C <sub>6</sub> H <sub>14</sub>	110-54-3	0.0-0.48%
Pentane	C <sub>5</sub> H <sub>12</sub>	109-66-0	0.0-0.75%
Carbon Monoxide	CO	630-08-0	0.0005-1.0%
Propane	C <sub>3</sub> H <sub>8</sub>	74-98-6	0.0-1.1%
Oxygen	O <sub>2</sub>	7782-44-7	0.0015-23.5%
Nitrogen	N <sub>2</sub>	7727-37-9	Balance

**4. FIRST-AID MEASURES**

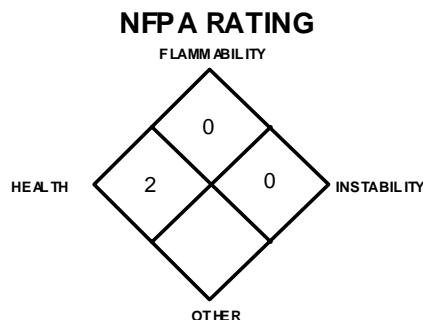
**RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS GAS MIXTURE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn.** No unusual health effects are anticipated after exposure to this gas mixture, due to the small cylinder size. If any adverse symptom develops after over-exposure to this gas mixture, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary. Contaminated person(s) who experience any adverse effect after over-exposure to this gas mixture must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

**MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:** Acute or chronic respiratory conditions or central nervous system disorders may be aggravated by over-exposure to this gas mixture. Due to the presence of Carbon Monoxide, exposure to this gas mixture may aggravate heart conditions.

**RECOMMENDATIONS TO PHYSICIANS:** Administer oxygen, if necessary; treat symptoms and eliminate exposure.

**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:** Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.  
**FIRE EXTINGUISHING MATERIALS NOT TO BE USED:** Although the Nitrogen Dioxide component is in trace levels, the use of halogenated extinguishing materials should be evaluated due to potential incompatibility.  
**UNUSUAL FIRE AND EXPLOSION HAZARDS:** This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire. Due to the presence of Nitrogen Dioxide, contact with this gas may cause irritation.



## 5. FIRE-FIGHTING MEASURES (Continued)

**UNUSUAL FIRE AND EXPLOSION HAZARDS (continued):**

Explosion Sensitivity to Mechanical Impact: Not sensitive.  
Explosion Sensitivity to Static Discharge: Not sensitive.

**SPECIAL FIRE-FIGHTING PROCEDURES:** Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. If water is not available for cooling or protection of cylinder exposures, evacuate the area.

## 6. ACCIDENTAL RELEASE MEASURES

**LEAK RESPONSE:** Due to the small size and content of the cylinder, an accidental release of this gas mixture presents significantly less risk of an oxygen deficient environment and other safety hazards than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel. Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for oxygen. Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.

If leaking incidentally from the cylinder, contact your supplier.

## 7. HANDLING and USE

**WORK PRACTICES AND HYGIENE PRACTICES:** Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms, due to oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify the cylinders containing this gas mixture. If there is a malfunction or another type of operational problem, contact nearest distributor immediately.

**STORAGE AND HANDLING PRACTICES:** Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C [70°F]). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage. Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**

**SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS:** **WARNING!** Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment is rated for proper service pressure.

**SPECIFIC USE(S):** This product is for use in various industries. Follow all industry standards for use.

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

## 8. EXPOSURE CONTROLS - PERSONAL PROTECTION

**VENTILATION AND ENGINEERING CONTROLS:** No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this gas mixture in well-ventilated areas. If this gas mixture is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of components and oxygen.

**EXPOSURE LIMITS:**

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR							OTHER  ppm
		ACGIH-TLVs		OSHA-PELs		NIOSH-RELs		NIOSH IDLH ppm	
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	STEL ppm		
Carbon Monoxide	630-08-0	25	NE	50 35 (Vacated 1989 PEL)	200 (Vacated 1989 PEL)	35	200 (ceiling)	1200	DFG MAKs: TWA = 5000 PEAK = 2•MAK 15 min. average value, 1-hr interval, 4-per shift DFG MAK Pregnancy Risk Classification: B
Hexane	110-54-3	50 (skin)	Skin	500 50 (Vacated 1989 PEL)	NE	50	NE	1100 (based on 10% of LEL)	DFG MAKs: TWA = 50 PEAK = 8•MAK 15 min. average value, 1-hr interval, 4-per shift DFG MAK Pregnancy Risk Classification: C Carcinogen: EPA-II
Nitrogen Dioxide	10102-44-0	3	5	NE	5 (ceiling) 1 (Vacated 1989 PEL)	NE	1	NE	DFG MAKs: TWA = 5000 PEAK = 1•MAK 15 min. average value, 1-hr interval, 4-per shift Carcinogen: TLV-A4
Oxygen	7782-44-7	There are no specific exposure limits for Oxygen. Oxygen levels should be maintained above 19.5%.							
Pentane	109-66-0	600	NE	100 600 (Vacated 1989 PEL)	750 (Vacated 1989 PEL)	120	610 (ceiling) 15 min.	1500 (based on 10% of LEL)	DFG MAKs: TWA = 50 PEAK = 2•MAK 15 min. average value, 1-hr interval, 4-per shift DFG MAK Pregnancy Risk Classification: C
Propane	74-898-6	1000	NE	1000	NE	1000	NE	2100 (based on 10% of LEL)	DFG MAKs: TWA = 1000 PEAK = 4•MAK 15 min. average value, 1-hr interval, 4-per shift DFG MAK Pregnancy Risk Classification: D
Nitrogen	7727-37-9	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.							

NE = Not Established.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) and equivalent standards of Canada (including CSA Standard Z94.4-02 and CSA Standard Z94.3-07.. Please reference applicable regulations and standards for relevant details.

**RESPIRATORY PROTECTION:** No special respiratory protection is required under normal circumstances of use. Maintain component levels below 50% of the TLVs of components (see previous page) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection when component levels exceed 50% of the TLV, oxygen levels are below 19.5%, or during emergency response to a release of this gas mixture. During an emergency situation, before entering the area, check the concentration of components and Oxygen. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards and Canadian CSA Standard Z94.4-02, the. 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).

## 8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

**RESPIRATORY PROTECTION (continued):** The following are NIOSH Respiratory Protective Equipment Guidelines for the toxic components of this gas mixture, Carbon Monoxide, Nitrogen Dioxide, Pentane and Propane:

### **CARBON MONOXIDE**

#### **CONCENTRATION**

Up to 350 ppm:  
Up to 875 ppm:  
Up to 1200 ppm:

#### **RESPIRATORY PROTECTION**

Any Supplied-Air Respirator (SAR).  
Any SAR operated in a continuous-flow mode.  
Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern, 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 providing protection against Carbon Monoxide, or any appropriate escape-type, SCBA.

### **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.

### **n-PENTANE**

#### **CONCENTRATION**

Up to 1200 ppm:  
Up to 1500 ppm:

#### **RESPIRATORY PROTECTION**

Any Supplied-Air Respirator (SAR).  
Any 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 organic vapor canister, or any appropriate escape-type, SCBA.

### **PROPANE**

#### **CONCENTRATION**

Up to 2100 ppm:

#### **RESPIRATORY PROTECTION**

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

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 appropriate escape-type, SCBA.

**EYE PROTECTION:** Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or the Canadian CSA Standard Z94.3-07.

**HAND PROTECTION:** Wear leather gloves when handling cylinders. Chemically resistant gloves should be worn when using this gas mixture. Use triple gloves for spill response. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

**BODY PROTECTION:** No special protection is needed under normal circumstances of use. If necessary, refer to 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 Nitrogen, the main component of this gas mixture.

**GAS DENSITY @ 32°F (0°C) and 1 atm:** .072 lbs/ft<sup>3</sup> (1.153 kg/m<sup>3</sup>)

**FREEZING/MELTING POINT @ 10 psig:** -345.8°F (-210°C)

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

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

**EVAPORATION RATE (nBuAc = 1):** Not applicable.

**VAPOR PRESSURE @ 70°F (21.1°C) (psig):** Not applicable.

**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.

**BOILING POINT:** -320.4°F (-195.8°C)

**pH:** Not applicable.

**MOLECULAR WEIGHT:** 28.01

**EXPANSION RATIO:** Not applicable.

**SPECIFIC VOLUME (ft<sup>3</sup>/lb):** 13.8

The following information is for this gas mixture.

**ODOR THRESHOLD:** For Nitrogen Dioxide: Reported values vary. 0.11-0.14 ppm (minimum perceptible value), 0.22 ppm (perception). Odor thresholds of 0.39 ppm and 5 ppm have also been reported.

**APPEARANCE, ODOR and COLOR:** This is a colorless to red-brown gas mixture with an acrid, pungent odor.

**HOW TO DETECT THIS SUBSTANCE (warning properties):** The odor is a distinctive characteristic 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:** Normally stable in gaseous state.

**DECOMPOSITION PRODUCTS:** *Combustion:* Nitrogen oxides, carbon oxides; above 160°C (320°F) Nitrogen Dioxide decomposes to nitric oxide and oxygen. *Hydrolysis:* Nitric acid, nitrous acid.

**MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE:** Titanium will burn in Nitrogen (the main component of this gas mixture). Lithium reacts slowly with Nitrogen at ambient temperatures. Oxygen is incompatible with combustible materials. The Carbon Monoxide component is mildly corrosive to nickel and iron (especially at high temperature and pressure). The trace Nitrogen Dioxide component is incompatible with acetic anhydride, alcohols, ammonia, boron trichloride, calcium, dimethyl sulfoxide, formaldehyde, hydrocarbons, nitrogen trichloride, triethylamine, tetramethyltin, unsaturated hydrocarbons, vinyl chloride, aluminum powder, carbon disulfide, halocarbons, nitroaromatics, hydrogen, oxygen, carbonyl metals, cyclopentadiene, hydrazine derivatives, pyridene or quinoline, metal acetylides or carbides and magnesium filings; however, due to the low levels in this gas mixture, these incompatibilities are not expected to be significant.

**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

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

**INHALATION:** Due to the small size of an individual cylinder of this product, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use, using proper personal protective equipment. A significant hazard associated with releases of this product is the potential for over-exposure to the Carbon Monoxide and Nitrogen Dioxide components of this gas mixture, which can reach exposure limits at the levels present in the mixture. In addition, inhalation exposure containing at or more than the Threshold Limit Value (TLV) of Carbon Monoxide (25 ppm) can result in serious health consequences. Carbon Monoxide is classified as a chemical asphyxiant, producing a toxic action by combining with the hemoglobin of the blood and replacing available oxygen; through this replacement the body is deprived of required oxygen and asphyxiation can occur. Since the affinity of Carbon Monoxide to hemoglobin is 200-300 times greater than that of oxygen, exposure to only a small amount can cause a toxic effect. Carbon Monoxide exposures in excess of 50 ppm can produce a toxic effect if breathed for a sufficient period of time.

Due to the presence of the trace Nitrogen Dioxide component, inhalation of this gas mixture may cause irritation of the respiratory system. Nose and throat irritation can occur at 15-25 ppm. Other symptoms can include coughing, a feeling of an inability to breathe (dyspnea), headache, and nausea. At 25-100 ppm, more severe symptoms can develop, including pneumonia (inflammation of the lungs) or bronchiolitis (inflammation of the small airways). These effects can be reversible. At concentrations exceeding 150 ppm, potentially fatal pulmonary edema (accumulation of fluid in the lungs) and progressive blockage of the small airways can 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 due to Nitrogen Dioxide presence. The onset of the symptoms of pulmonary edema can be delayed for hours or days after the exposure. 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.

Another significant health hazard associated with this gas mixture is when it contains less than 19.5% Oxygen and is released in a small, poorly-ventilated area (i.e. an enclosed or confined space). Under this circumstance, an oxygen-deficient environment may occur. 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 over-exposure, death may occur. The effects associated with various levels of oxygen are as follows:

**CONCENTRATION OF OXYGEN**

12-16% Oxygen:  
10-14% Oxygen:  
6-10% Oxygen:  
Below 6%:

**OBSERVED EFFECT**

Breathing and pulse rate increased, muscular coordination slightly disturbed.  
Emotional upset, abnormal fatigue, disturbed respiration.  
Nausea, vomiting, collapse, or loss of consciousness.  
Convulsive movements, possible respiratory collapse, and death.

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

**CONTACT WITH SKIN or EYES:** The gas may be irritating to the skin. Contact in the presence of moisture or water may result in the formation of nitric and nitrous acids, which can cause burns if contact under these circumstances is prolonged. Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of skin over-exposure may include scratchiness, pain, and redness and burns. Contact with the eyes will cause immediate irritation. Prolonged eye exposure may result in damage to the eyes due to the formation of nitric and nitrous acids.

**HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms.** Over-exposure to this gas mixture may cause the following health effects:

**ACUTE:** Due to the small size of the individual cylinder of this product, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. If inhalation occurs, toxic effects from Nitrogen Dioxide may occur. Inhalation of high concentrations of the mixture, as may occur in a confined space, may result in an oxygen-deficient atmosphere and asphyxiation. Contact with the skin may be irritating. Eye contact is highly irritating. A sudden release of pressure from the cylinder may cause frostbite to exposed tissues.

**CHRONIC:** Abnormal color perception and pigment changes in the eyes have been reported from persons exposed to 420-1300 ppm of Hexane for five years. Additionally, long-term exposure to Hexane and Pentane can adversely affect the peripheral nervous system. Chronic exposure to Pentane, Hexane and Propane may result in sensitization of the heart to epinephrine (based on animal data). Chronic low-level inhalation exposure may cause permanent damage to the lungs. Chronic low-level exposure to the skin may cause dermatitis. Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system.

**TARGET ORGANS:** ACUTE: Respiratory system, central nervous system. CHRONIC: Skin, respiratory system, heart, peripheral nervous and central nervous system.

**TOXICITY DATA:** Data are available for the Oxygen component, but since these data are from hyperbaric exposure to oxygen, which is an unlikely exposure to this gas mixture, the data are not presented in this MSDS. No data are applicable to the main component, Nitrogen, as it is a simple asphyxiant. The following are toxicological data available for the remaining components in 1% concentration or greater.

**CARBON MONOXIDE:**

LCLo (Inhalation-Human) 4 mg/m<sup>3</sup>/12 hours: Behavioral: coma; Vascular: BP lowering not characterized in autonomic section; Blood: methemoglobinemia-carboxyhemoglobin  
LCLo (Inhalation-Human) 5000 ppm/5 minutes  
LCLo (Inhalation-Human) 3520 mg/m<sup>3</sup>/5 minutes: Behavioral: headache  
LCLo (Inhalation-Human) 3400 mg/m<sup>3</sup>/20 minutes: Cardiac: pulse rate; Lungs, Thorax, or Respiration: respiratory depression  
LCLo (Inhalation-Human) 5700 mg/m<sup>3</sup>/2  
LCLo (Inhalation-Human) 14,080 mg/m<sup>3</sup>/1 minute: Gastrointestinal: nausea or vomiting; Behavioral: general anesthetic  
LCLo (Inhalation-Man) 4000 ppm/30 minutes  
TCLo (Inhalation-Human) 600 mg/m<sup>3</sup>/10 minutes: Behavioral: headache  
TCLo (Inhalation-Human) 6 mg/m<sup>3</sup>/2 minutes: Sense Organs and Special Senses (Eye): effect, not otherwise specified  
TCLo (Inhalation-Human) 11 mg/m<sup>3</sup>/5 hours: Behavioral: alteration of classical conditioning  
TCLo (Inhalation-Human) 31 mg/m<sup>3</sup>/3 hours: Sense Organs and Special Senses (Eye): visual field changes  
TCLo (Inhalation-Human) 33 mg/m<sup>3</sup>/6 hours: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)  
TCLo (Inhalation-Human) 50 mg/m<sup>3</sup>/2 hours: Sense Organs and Special Senses (Ear): change in acuity; Brain and Coverings: changes in surface EEG  
TCLo (Inhalation-Human) 50 mg/m<sup>3</sup>/5 hours: Behavioral: changes in psychophysiological tests

**CARBON MONOXIDE (continued):**

TCLo (Inhalation-Human) 55 mg/m<sup>3</sup>/8 hours: Sense Organs and Special Senses (Eye): effect, not otherwise specified  
TCLo (Inhalation-Human) 60 mg/m<sup>3</sup>/6 hours: Cardiac: pulse rate Brain and Coverings: changes in surface EEG  
TCLo (Inhalation-Human) 80 mg/m<sup>3</sup>/3 hours: Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: changes in psychophysiological tests; Behavioral: ataxia  
TCLo (Inhalation-Human) 220 mg/m<sup>3</sup>/1 hour: Behavioral: headache  
TCLo (Inhalation-Human) 220 mg/m<sup>3</sup>/3 hours: Behavioral: somnolence (general depressed activity)  
TCLo (Inhalation-Human) 230 mg/m<sup>3</sup>/6 hours: Brain and Coverings: increased intracranial pressure; Behavioral: somnolence (general depressed activity)  
TCLo (Inhalation-Human) 440 mg/m<sup>3</sup>/4 hours: Behavioral: headache; Gastrointestinal: nausea or vomiting  
TCLo (Inhalation-Human) 440 mg/m<sup>3</sup>/1 hour: Behavioral: headache; Cardiac: pulse rate increase, without fall in BP  
TCLo (Inhalation-Human) 460 mg/m<sup>3</sup>/4 hours: Behavioral: headache, somnolence (general depressed activity); Vascular: BP lowering not characterized in autonomic section  
TCLo (Inhalation-Human) 660 mg/m<sup>3</sup>/2 hours: Gastrointestinal: nausea or vomiting  
TCLo (Inhalation-Human) 660 mg/m<sup>3</sup>/4 hours: Behavioral: general anesthetic  
TCLo (Inhalation-Human) 800 mg/m<sup>3</sup>/5 minutes: Behavioral: headache, somnolence (general depressed activity)  
TCLo (Inhalation-Human) 800 mg/m<sup>3</sup>/20 minutes: Gastrointestinal: nausea or vomiting; Behavioral: muscle weakness

**HAZARDOUS MATERIAL IDENTIFICATION SYSTEM**

**HEALTH HAZARD**

(BLUE) 2

**FLAMMABILITY HAZARD**

(RED) 0

**PHYSICAL HAZARD**

(YELLOW) 0

**PROTECTIVE EQUIPMENT**

EYES      RESPIRATORY      HANDS      BODY

See Section 8

For Routine Industrial Use and Handling Applications

## 11. TOXICOLOGICAL INFORMATION (Continued)

### TOXICITY DATA (continued):

#### CARBON MONOXIDE (continued):

TCLo (Inhalation-Human) 800 mg/m<sup>3</sup>/3 hours: Cardiac: pulse rate increase, without fall in BP; Vascular: BP lowering not characterized in autonomic section

TCLo (Inhalation-Human) 880 mg/m<sup>3</sup>/2 hours: Behavioral: somnolence (general depressed activity), general anesthetic; Vascular: BP lowering not characterized in autonomic section

TCLo (Inhalation-Human) 880 mg/m<sup>3</sup>/4 hours: Behavioral: tetany, coma

TCLo (Inhalation-Human) 1260 mg/m<sup>3</sup>/90 minutes: Cardiac: pulse rate increase, without fall in BP; Behavioral: coma, tetany

TCLo (Inhalation-Human) 1300 mg/m<sup>3</sup>/2 hours: Gastrointestinal: nausea or vomiting; Cardiac: pulse rate increase, without fall in BP; Behavioral: headache

TCLo (Inhalation-Human) 1350 mg/m<sup>3</sup>/33 minutes: Cardiac: pulse rate increase, without fall in BP; Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: alteration of classical conditioning

TCLo (Inhalation-Human) 1760 mg/m<sup>3</sup>/20 minutes: Behavioral: headache; Gastrointestinal: nausea or vomiting

TCLo (Inhalation-Human) 1760 mg/m<sup>3</sup>/2 hours: Behavioral: general anesthetic; Vascular: BP lowering not characterized in autonomic section

TCLo (Inhalation-Human) 1800 mg/m<sup>3</sup>/1 hour: Lungs, Thorax, or Respiration: respiratory depression; Cardiac: change in force of contraction

TCLo (Inhalation-Human) 2000 mg/m<sup>3</sup>/12 minutes: Behavioral: tetany, coma

TCLo (Inhalation-Human) 3000 mg/m<sup>3</sup>/1 hour

TCLo (Inhalation-Human) 2300 mg/m<sup>3</sup>/30 minutes: Behavioral: general anesthetic; Vascular: BP lowering not characterized in autonomic section

TCLo (Inhalation-Human) 3520 mg/m<sup>3</sup>/30 minutes: Behavioral: general anesthetic; Gastrointestinal: nausea or vomiting

TCLo (Inhalation-Human) 5000 mg/m<sup>3</sup>/17 minutes: Behavioral: general anesthetic, tetany

TCLo (Inhalation-Man) 650 ppm/45 minutes: Blood: methemoglobinemia-carboxyhemoglobin; Behavioral: changes in psychophysiological tests

TCLo (Inhalation-Rat) 2 pph/30 days-intermittent: Behavioral: somnolence (general depressed activity)

LC<sub>50</sub> (Inhalation-Rat) 1807 ppm/4 hours

LC<sub>50</sub> (Inhalation-Rat) 1900 mg/m<sup>3</sup>/4 hours

LC<sub>50</sub> (Inhalation-Rat) 13,500 mg/m<sup>3</sup>/15 minutes

LC<sub>50</sub> (Inhalation-Rat) 6600 ppm/30 minutes

LC<sub>30</sub> (Inhalation-Rat) 24,000 ppm/5 minutes: Lungs, Thorax, or Respiration: respiratory obstruction; Blood: other changes; Nutritional and Gross Metabolic: metabolic acidosis

LC<sub>50</sub> (Inhalation-Mouse) 2444 ppm/4 hours

LC<sub>50</sub> (Inhalation-Mouse) 2230 mg/m<sup>3</sup>/2 hours

LC<sub>50</sub> (Inhalation-Guinea Pig) 5718 ppm/4 hours

LC<sub>50</sub> (Inhalation-Bird-Wild Bird Species) 1334 ppm

LC (Inhalation-Rat) 5200 mg/m<sup>3</sup>/1 hour

LC (Inhalation-Mouse) 1900 mg/m<sup>3</sup>/2 hours

LCLo (Inhalation-Dog) 4000 ppm/46 minutes

LCLo (Inhalation-Rabbit) 4000 ppm

LCLo (Inhalation-Rabbit) 17,200 mg/m<sup>3</sup>/40 minutes

LCLo (Inhalation-Rabbit) 20,000 mg/m<sup>3</sup>/60 minutes

LCLo (Inhalation-Cat) 500 mg/m<sup>3</sup>/30 minutes

LCLo (Inhalation-Cat) 34,400 mg/m<sup>3</sup>/3 minutes

LCLo (Inhalation-Dog) 23,000 mg/m<sup>3</sup>/20 minutes

LCLo (Inhalation-Guinea Pig) 4600 mg/m<sup>3</sup>/2 hours

LCLo (Inhalation-Guinea Pig) 10,300 mg/m<sup>3</sup>/60 minutes

LCLo (Inhalation-Mammal-Species Unspecified) 5000 ppm/5 minutes

LCLo (Inhalation-Mammal-Domestic) 1 pph/2 hours: Brain and Coverings: changes in surface EEG, other degenerative changes, Behavioral: general anesthetic

TCLo (Inhalation-Rat) 40 mg/m<sup>3</sup>/4 hours: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)

TCLo (Inhalation-Rat) 88 mg/m<sup>3</sup>/20 minutes: Nutritional and Gross Metabolic: changes in phosphorus

TCLo (Inhalation-Rat) 176 mg/m<sup>3</sup>/20 minutes: Brain and Coverings: other degenerative changes

TCLo (Inhalation-Rat) 800 mg/m<sup>3</sup>/4 hours: Behavioral: altered sleep time (including change in righting reflex)

TCLo (Inhalation-Rat) 2000 mg/m<sup>3</sup>/11 minutes: Behavioral: alteration of classical conditioning

TCLo (Inhalation-Rat) 1000 ppm/5 minutes: Lungs, Thorax, or Respiration: respiratory stimulation; Blood: other changes

TCLo (Inhalation-Rat) 1005 ppm/90 minutes: Brain and Coverings: recordings from specific areas of CNS

TCLo (Inhalation-Rat) 50 ppm/2 hours: Blood: methemoglobinemia-carboxyhemoglobin

TCLo (Inhalation-Rat) 4000 ppm/15 minutes: Brain and Coverings: other degenerative changes; Behavioral: alteration of classical conditioning; Blood: methemoglobinemia-carboxyhemoglobin

TCLo (Inhalation-Rat) 1000 ppm/40 minutes: Brain and Coverings: changes in circulation (hemorrhage, thrombosis, etc.); Vascular: measurement of regional blood flow; Biochemical: Metabolism (Intermediary): amino acids (including renal excretion)

TCLo (Inhalation-Rat) 0.3 pph/40 minutes: Behavioral: somnolence (general depressed activity); Blood: methemoglobinemia-carboxyhemoglobin; Biochemical: Neurotransmitters or modulators (putative): dopamine in striatum

TCLo (Inhalation-Rat) 1000 ppm: Blood: other changes

TCLo (Inhalation-Rat) 12,000 ppm

TCLo (Inhalation-Rat) 3000 ppm/60 minutes: Brain and Coverings: other degenerative changes

TCLo (Inhalation-Rat) 24,000 ppm/4 minutes: Lungs, Thorax, or Respiration: respiratory depression

TCLo (Inhalation-Rat) 500 ppm/5 minutes: Blood: methemoglobinemia-carboxyhemoglobin

TCLo (Inhalation-Rat) 105 ppm/7 days-continuous: Cardiac: cardiomegaly; Blood: other changes; Cardiac: change in force of contraction

TCLo (Inhalation-Rat) 315 ppm/21 days-continuous: Cardiac: changes in coronary arteries, arrhythmias (including changes in conduction)

TCLo (Inhalation-Rat) 3000 ppm/40 minutes: Brain and Coverings: other degenerative changes

TCLo (Inhalation-Rat) 1800 ppm/1 hour/14 days-intermittent: Cardiac: other changes

TCLo (Inhalation-Rat) 96 ppm/24 hours/90 days-continuous: Blood: pigmented or nucleated red blood cells, other changes

TCLo (Inhalation-Rat) 250 ppm/5 hours/20 days-intermittent: Blood: pigmented or nucleated red blood cells, changes in other cell count (unspecified), changes in erythrocyte (RBC) count

TCLo (Inhalation-Rat) 375 mg/m<sup>3</sup>/5 hours/20 weeks-intermittent: Vascular: structural changes in vessels; Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol), other changes

TCLo (Inhalation-Rat) 10 mg/m<sup>3</sup>/4 hours/10 weeks-intermittent: Brain and Coverings: other degenerative changes; Cardiac: other changes; Endocrine: other changes

TCLo (Inhalation-Rat) 53 mg/m<sup>3</sup>/30 days-continuous: Liver: other changes; Blood: changes in cell count (unspecified); Nutritional and Gross Metabolic: weight loss or decreased weight gain

TCLo (Inhalation-Rat) 100 mg/m<sup>3</sup>/1 week-continuous: Liver: other changes; Blood: changes in cell count (unspecified); Nutritional and Gross Metabolic: weight loss or decreased weight gain

TCLo (Inhalation-Rat) 75 ppm/24 hours: female 0-20 day(s) after conception: Reproductive: Maternal Effects: other effects; Effects on Newborn: behavioral

TCLo (Inhalation-Rat) 150 ppm/24 hours: female 1-22 day(s) after conception: Reproductive: Specific Developmental Abnormalities: cardiovascular (circulatory) system

#### CARBON MONOXIDE (continued):

TCLo (Inhalation-Rat) 150 ppm/24 hours: female 1-22 day(s) after conception: Reproductive: Effects on Newborn: growth statistics (e.g.%, reduced weight gain), behavioral

TCLo (Inhalation-Rat) 1 mg/m<sup>3</sup>/24 hours: female 72 day(s) pre-mating: Reproductive: Maternal Effects: menstrual cycle changes or disorders, parturition; Fertility: female fertility index (e.g. # females pregnant per # sperm positive females; # females pregnant per # females mated)

TCLo (Inhalation-Rat) 150 ppm/24 hours: female 0-20 day(s) after conception: Reproductive: Effects on Newborn: behavioral

TCLo (Inhalation-Rat) 75 ppm/24 hours: female 0-20 day(s) after conception: Reproductive: Specific Developmental Abnormalities: immune and reticuloendothelial system

TCLo (Inhalation-Rat) 150 ppm: female 0-20 day(s) after conception: Reproductive: Maternal Effects: other effects; Effects on Newborn: biochemical and metabolic, physical

TCLo (Inhalation-Mouse) 500 ppm: female 7-18 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), fetal death

TCLo (Inhalation-Mouse) 125 ppm: female 1-7 day(s) after conception: Reproductive: Effects on Newborn: live birth index (measured after birth), viability index (e.g., # alive at day 4 per # born alive)

TCLo (Inhalation-Mouse) 1000 ppm/40 minutes: Brain and Coverings: changes in circulation (hemorrhage, thrombosis, etc.); Vascular: measurement of regional blood flow; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other oxidoreductases

TCLo (Inhalation-Mouse) 50 ppm/30 days-intermittent: Lungs, Thorax, or Respiration: structural or functional change in trachea or bronchi

TCLo (Inhalation-Mouse) 10 mg/m<sup>3</sup>/4 hours/10 weeks-intermittent: Brain and Coverings: other degenerative changes; Cardiac: other changes; Endocrine: other changes

TCLo (Inhalation-Mouse) 65 ppm/24 hours: female 7-18 day(s) after conception: Reproductive: Effects on Newborn: behavioral

TCLo (Inhalation-Mouse) 250 ppm/7 hours: female 6-15 day(s) after conception: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants); Specific Developmental Abnormalities: musculoskeletal system

TCLo (Inhalation-Mouse) 125 ppm/24 hours: female 7-18 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)

TCLo (Inhalation-Mouse) 8 pph/1 hour: female 8 day(s) after conception: Reproductive: Fertility: litter size (e.g. # fetuses per litter; measured before birth); Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), fetal death

TCLo (Inhalation-Mouse) 8 pph/1 hour: female 8 day(s) after conception: Reproductive: Specific Developmental Abnormalities: Central Nervous System

TCLo (Inhalation-Mouse) 103 mg/m<sup>3</sup>: female 1-21 day(s) after conception: Reproductive: Fertility: litter size (e.g. # fetuses per litter; measured before birth); Specific Developmental Abnormalities: cardiovascular (circulatory) system; Effects on Newborn: growth statistics (e.g.%, reduced weight gain)

TCLo (Inhalation-Cat) 50 mg/m<sup>3</sup>/60 minutes: Behavioral: alteration of classical conditioning

TCLo (Inhalation-Cat) 2000 mg/m<sup>3</sup>/20 minutes: Behavioral: alteration of classical conditioning

TCLo (Inhalation-Dog) 2000 mg/m<sup>3</sup>/30 minutes: Behavioral: alteration of classical conditioning

TCLo (Inhalation-Guinea Pig) 2000 mg/m<sup>3</sup>/30 minutes: Behavioral: alteration of classical conditioning

TCLo (Inhalation-Guinea Pig) 200 mg/m<sup>3</sup>/5 hours/4 weeks-intermittent: Endocrine: hyperglycemia

TCLo (Inhalation-Guinea Pig) 200 mg/m<sup>3</sup>/5 hours/30 weeks-intermittent: Cardiac: arrhythmias (including changes in conduction), EKG changes not diagnostic of specified effects, pulse rate increase, without fall in BP

TCLo (Inhalation-Guinea Pig) 200 ppm/24 hours/90days-continuous: Blood: pigmented or nucleated red blood cells, other changes

TCLo (Inhalation-Guinea Pig) 100 mg/m<sup>3</sup>/10weeks-continuous: Endocrine: effect on menstrual cycle

TCLo (Inhalation-Guinea Pig) 16 pph/48 hours-continuous: Brain and Coverings: other degenerative changes; Liver: other changes Kidney/Ureter/Bladder: other changes

TCLo (Inhalation-Guinea Pig) 200 ppm/10 hours: female 23-61 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus); Specific Developmental Abnormalities: Central Nervous System, hepatobiliary system

TCLo (Inhalation-Guinea Pig) 550 mg/m<sup>3</sup>: female 20-40 day(s) after conception: Reproductive: Fertility: abortion; Specific Developmental Abnormalities: Central Nervous System Reproductive: Effects on Newborn: viability index (e.g., # alive at day 4 per # born alive)

TCLo (Inhalation-Guinea Pig) 480 mg/m<sup>3</sup>: female 20-50 day(s) after conception: Reproductive: Fertility: abortion, Specific Developmental Abnormalities: Central Nervous System Reproductive: Effects on Newborn: viability index (e.g., # alive at day 4 per # born alive)

TCLo (Inhalation-Guinea Pig) 100 mg/m<sup>3</sup>: female 10 week(s) pre-mating: Reproductive: Fertility: pre-implantation mortality (e.g. reduction in number of implants per female; total number of implants per corpora lutea), litter size (e.g. # fetuses per litter; measured before birth); Effects on Newborn: growth statistics (e.g.%, reduced weight gain)

TCLo (Inhalation-Guinea Pig) 100 mg/m<sup>3</sup>: female 10 week(s) pre-mating: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)

TCLo (Inhalation-Guinea Pig) 6600 mg/m<sup>3</sup>/10 minutes: Lungs, Thorax, or Respiration: acute pulmonary edema

TCLo (Inhalation-Monkey) 1145 mg/m<sup>3</sup>/30 minutes: Cardiac: other changes; Liver: multiple effects; Lungs, Thorax, or Respiration: other changes

TCLo (Inhalation-Monkey) 200 ppm/24 hours/90days-continuous: Blood: pigmented or nucleated red blood cells, other changes

TCLo (Inhalation-Monkey) 110 mg/m<sup>3</sup>/90 days-intermittent: Cardiac: other changes

TCLo (Inhalation-Rabbit) 200 mg/m<sup>3</sup>/3 hours/13 weeks-intermittent: Brain and Coverings: other degenerative changes; Cardiac: other changes; Blood: hemorrhage

TCLo (Inhalation-Rabbit) 50 ppm/24 hours/8 weeks-continuous: Blood: changes in platelet count

TCLo (Inhalation-Rabbit) 110 mg/m<sup>3</sup>/1 year-intermittent: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)

TCLo (Inhalation-Rabbit) 170 mg/m<sup>3</sup>/45 days-intermittent: Vascular: structural changes in vessels

TCLo (Inhalation-Rabbit) 4.5 pph/13days-continuous: Brain and Coverings: other degenerative changes; Liver: other changes; Kidney/Ureter/Bladder: other changes

TCLo (Inhalation-Rabbit) 180 ppm/24 hours: female 1-30 day(s) after conception: Reproductive: Effects on Newborn: stillbirth, viability index (e.g., # alive at day 4 per # born alive)

TCLo (Inhalation-Mammal-Domestic) 1 pph: Brain and Coverings: changes in surface EEG; Behavioral: somnolence (general depressed activity), Enzyme inhibition, induction, or change in blood or tissue levels: multiple enzyme effects

TCLo (Inhalation-Mammal-Domestic) 1 pph/120 minutes: Brain and Coverings: other degenerative changes; Behavioral: somnolence (general depressed activity), Enzyme inhibition, induction, or change in blood or tissue levels: multiple enzyme effects

TCLo (Inhalation-Mammal-Domestic) 1%/45 minutes: Cardiac: pulse rate increase, without fall in BP

## 11. TOXICOLOGICAL INFORMATION (Continued)

### TOXICITY DATA (continued):

#### CARBON MONOXIDE (continued):

TCLo (Inhalation-Rat) 150 ppm: female 1-20 day(s) after conception: Reproductive: Specific Developmental Abnormalities: Central Nervous System  
 TCLo (Inhalation-Rat) 103 mg/m<sup>3</sup>: female 1-22 day(s) after conception: Reproductive: Fertility: litter size (e.g. # fetuses per litter; measured before birth); Specific Developmental Abnormalities: cardiovascular (circulatory) system; Effects on Newborn: growth statistics (e.g.%, reduced weight gain)  
 TCLo (Inhalation-Rat) 100 mg/m<sup>3</sup>/2 hours: Peripheral Nerve and Sensation: recording from peripheral motor nerve  
 TCLo (Inhalation-Mouse) 65 ppm: female 1-14 day(s) after conception: Reproductive: Effects on Newborn: viability index (e.g., # alive at day 4 per # born alive)  
 TCLo (Inhalation-Mammal-Domestic) 1%/65 minutes: Nutritional and Gross Metabolic: metabolic acidosis; Brain and Coverings: other degenerative changes; Behavioral: somnolence (general depressed activity)  
 TCLo (Inhalation-Mammal-Domestic) 1%/95 minutes: Brain and Coverings: other degenerative changes; Behavioral: somnolence (general depressed activity); Nutritional and Gross Metabolic: body temperature decrease  
 TCLo (Inhalation-Mammal-Domestic) 1%/100 minutes: Brain and Coverings: other degenerative changes; Behavioral: somnolence (general depressed activity); Nutritional and Gross Metabolic: body temperature decrease

#### CARBON MONOXIDE (continued):

TCLo (Inhalation-Mammal-Domestic) 1%/120 minutes: Brain and Coverings: other degenerative changes; Behavioral: somnolence (general depressed activity); Nutritional and Gross Metabolic: body temperature decrease  
 TCLo (Inhalation-Mammal-Domestic) 1%/150 minutes: Brain and Coverings: other degenerative changes; Behavioral: somnolence (general depressed activity); Nutritional and Gross Metabolic: body temperature decrease  
 TDLo (Subcutaneous-Rat) 5983 mg/kg/18 weeks-intermittent: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)  
 TDLo (Intraperitoneal-Rat) 35 mL/kg: Sense Organs and Special Senses (Ear): changes in cochlear structure or function  
 TDLo (Intraperitoneal-Mouse) 2240.8 µg/kg: Biochemical; Metabolism (Intermediary): effect on inflammation or mediation of inflammation  
 TDLo (Intraperitoneal-Mouse) 700 mL/kg/7 days-intermittent: Brain and Coverings: recordings from specific areas of CNS; Behavioral: changes in psychophysiological tests; Related to Chronic Data: death  
 TDLo (Intraperitoneal-Mouse) 700 mL/kg/7 days-intermittent: Brain and Coverings: other degenerative changes; Behavioral: changes in psychophysiological tests; Related to Chronic Data: death  
 Micronucleus Test (Inhalation-Mouse) 1500 ppm/10 minutes  
 Sister Chromatid Exchange (Inhalation-Mouse) 2500 ppm/10 minutes

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

**Hexane:** EPA II (Inadequate Information for Assess Carcinogenic Potential)

**Nitrogen Dioxide:** ACGIH TLV-A4 (Not Classifiable as a Human Carcinogen)

The remaining components of this gas mixture are not found on the following lists: U.S. EPA, U.S. NTP, U.S. OSHA, U.S. NIOSH, GERMAN MAK, IARC, or ACGIH; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

**IRRITANCY OF PRODUCT:** Due to the presence of Nitrogen Dioxide, skin contact may cause irritation. Due to the presence of Nitrogen Dioxide, eye contact may cause irritation. Contact with rapidly expanding gases can be irritating to exposed skin and eyes.

**SENSITIZATION TO THE PRODUCT:** Chronic exposure to Pentane, Hexane and Propane may result in sensitization of the heart to epinephrine (based on animal data).

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

**Mutagenicity:** The components of this gas mixture are not reported to cause mutagenic effects in humans. In the one animal study available, Carbon Monoxide gas increased chromosomal damage in blood cells of mice. In studies involving the Nitrogen Dioxide component, positive results have been obtained in one study using live animals. Positive results have also been obtained in bacteria and cultured mammalian cells.

**Embryotoxicity:** Severe acute exposures to the Carbon Monoxide component during pregnancy have caused adverse effects and death of the fetus. In general, maternal symptoms are an indicator of the potential risk to the fetus since Carbon Monoxide is toxic to the mother before it becomes toxic to the fetus. No specific human information on effects of chronic exposure to Carbon monoxide during pregnancy. Animal studies suggest that repeated exposure to relatively high levels of Carbon Monoxide during pregnancy may cause developmental effects without causing maternal toxicity.

**Teratogenicity:** Severe acute exposures to the Carbon Monoxide component during pregnancy have caused adverse effects and death of the fetus. See above 'Embryotoxicity' for more information.

**Reproductive Toxicity:** The components of this gas mixture are not reported to cause reproductive effects in humans.

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

**BIOLOGICAL EXPOSURE INDICES (BEIs):** Currently, the following Biological Exposure Indices (BEIs) have been determined for the Carbon Monoxide component of this gas mixture.

CHEMICAL: DETERMINANT	SAMPLING TIME	BEI
Carbon Monoxide • Carboxyhemoglobin in blood • Carboxyhemoglobin in end-exhaled air	• End of shift • End of shift	• 3.5% of Hemoglobin • 20 ppm
Hexane • 2,5-Hexanedione in urine	• End of shift at end of workweek	• 0.4 mg/L

## 12. ECOLOGICAL INFORMATION

**ENVIRONMENTAL STABILITY:** The gas will be dissipated rapidly in well-ventilated areas.

**EFFECT OF MATERIAL ON PLANTS or ANIMALS:** Any adverse effect on plants would be related to oxygen-deficient environments or frost from rapidly expanding gases, unless exposure occurs in a confined space or potential toxicity of exposure to Nitrogen Dioxide.

**EFFECT OF CHEMICAL ON AQUATIC LIFE:** Due to the presence of Nitrogen Dioxide in this mixture, release near an aquatic environment may cause harm.

**MOBILITY:** Nitrogen is inert and does not present a hazard of mobility. When released to soil, the Nitrogen Dioxide component is expected to decompose to nitric acid in moist soil surfaces. Nitrogen Dioxide is expected to volatilize from dry soil surfaces based upon its vapor pressure. If released to soil, the Hexane component is expected to have high mobility based upon an estimated Koc of 150. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 1.83 atm-cu m/mole. Hexane may volatilize from dry soil surfaces based upon its vapor pressure. If released to soil, the Pentane component is expected to have high mobility based upon an estimated Koc of 80. Volatilization from moist soil surfaces is expected to be an important fate process based upon a Henry's Law constant of 1.25 atm-cu m/mole. Pentane may volatilize from dry soil surfaces based upon its vapor pressure. If released to soil, the Propane component is expected to have moderate mobility based upon an estimated Koc of 460. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 7.07X10<sup>-1</sup> atm-cu m/mole. Propane will volatilize from dry soil surfaces based upon its vapor pressure.

**PERSISTENCE AND BIODEGRADABILITY:** Persistence: Nitrogen is a natural element and presents no hazard of persistence. The reaction of the Nitrogen Dioxide component 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. The Hexane, Pentane and Propane components will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. The half-life of each of these materials is as follows: Hexane = 3 days; Pentane = 4 days; Propane = 14 days.

Propane does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight. Biodegradation: Nitrogen and Nitrogen Dioxide do not biodegrade. Propane is utilized by Microbacterium vaccae, and is readily degraded by soil bacteria. Mycobacterium phlei is capable of growing on Propane as the only carbon source. Propane is suggested to be metabolized by the various microorganisms via the malonyl succinate pathway. Screening studies suggest that the Hexane and Pentane components will undergo biodegradation in soil and water surfaces, but volatilization is expected to be the predominant fate process in the environment.

## 12. ECOLOGICAL INFORMATION (Continued)

**POTENTIAL TO BIOACCUMULATE:** The Nitrogen and Nitrogen Dioxide components of this gas mixture will not bioaccumulate. An estimated BCF of 200 was calculated for the Hexane component, using a log Kow of 3.90 and a regression-derived equation. According to a classification scheme, this BCF suggests the potential for bioconcentration in aquatic organisms is high. An estimated BCF of 80 was calculated for the Pentane component, using a log Kow of 3.39 and a regression-derived equation. According to a classification scheme, this BCF suggests the potential for bioconcentration in aquatic organisms is moderate. An estimated BCF of 13 was calculated in fish for Propane, using a log Kow of 2.36 and a regression-derived equation. According to a classification scheme, this BCF suggests the potential for bioconcentration in aquatic organisms is low to moderate.

**OZONE-DEPLETION POTENTIAL:** Components are not Class I or Class II ozone depleting chemicals (40 CFR Part 82). A photochemical model was used to quantify the sensitivity of the tropospheric oxidants Ozone (O<sub>3</sub>) and Hydroxide Ion (OH) to changes in Carbon Monoxide (CO) emissions and to perturbations in climate and stratospheric chemistry. In most cases, increased CO emissions will suppress OH<sup>-</sup> (negative coefficients) in increased O<sub>3</sub> (positive coefficients) except in areas where NO and O<sub>3</sub> influenced by pollution are sufficient to increase OH<sup>-</sup>. In most regions, CO emission increase will suppress OH<sup>-</sup> and increase O<sub>3</sub>, but these trends may be opposed by stratospheric O<sub>3</sub> depletion and climate change.

**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. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

## 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, Oxygen, Propane)  
**HAZARD CLASS NUMBER and DESCRIPTION:** 2.2 (Non-Flammable Gas)  
**UN IDENTIFICATION NUMBER:** UN 1956  
**PACKING GROUP:** Not applicable.  
**DOT LABEL(S) REQUIRED:** Class 2.2 (Non-Flammable Gas)  
**NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2008):** 126

**MARINE POLLUTANT:** The components of this gas mixture are not classified by the DOT as 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 can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

**Note:** DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

**TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:** This gas is classified as Dangerous Goods, per regulations of Transport Canada.

**PROPER SHIPPING NAME:** Compressed gases, n.o.s. (Nitrogen, Oxygen, Propane)  
**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 (2008):** 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).

**INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):** This gas mixture is classified as Dangerous Goods, per the International Air Transport Association.

**UN IDENTIFICATION NUMBER:** UN 1956  
**PROPER SHIPPING NAME:** Compressed gases, n.o.s. (Nitrogen, Oxygen, Propane)  
**HAZARD CLASS NUMBER and DESCRIPTION:** 2.2 (Non-Flammable Gas)  
**HAZARD LABEL(S) REQUIRED:** Class 2.2 (Non-Flammable Gas)  
**PACKING GROUP:** None  
**PASSENGER & CARGO AIRCRAFT LIMITED QUANTITY PACKING INSTRUCTION:** None  
**PASSENGER & CARGO AIRCRAFT LIMITED QUANTITY MAXIMUM NET QUANTITY/PKG:** None  
**PASSENGER & CARGO AIRCRAFT PACKING INSTRUCTION:** 200  
**PASSENGER & CARGO AIRCRAFT MAXIMUM NET QUANTITY/PKG:** 75 kg  
**CARGO AIRCRAFT ONLY PACKING INSTRUCTION:** 200  
**CARGO AIRCRAFT ONLY MAXIMUM NET QUANTITY/PKG:** 150 kg  
**SPECIAL PROVISIONS:** None  
**ERG CODE:** 2L

## 15. REGULATORY INFORMATION

**ADDITIONAL U.S. REGULATIONS:**

**U.S. SARA REPORTING REQUIREMENTS:** The components of this gas mixture 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)
Hexane	No	No	Yes
Nitrogen Dioxide	Yes	Yes	Yes

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

**U.S. SARA 304 EXTREMELY HAZARDOUS REPORTABLE QUANTITY (RQ):** Nitrogen Dioxide = 100 lb (4.54 kg)

**U.S. CERCLA REPORTABLE QUANTITY (RQ):** Hexane = 5000 lb (2270 kg); Nitrogen Dioxide = 100 lb (4.54 kg)

**U.S. TSCA INVENTORY STATUS:** The components of this gas mixture are listed on the TSCA Inventory.

**U.S. EPA CLEAN WATER ACT SECTIONS 301, 307, and 311:** Not applicable.

**U.S. EPA REGULATED SUBSTANCES, PER 40 CFR, PART 68, OF THE RISK MANAGEMENT FOR CHEMICAL**

## 15. REGULATORY INFORMATION (Continued)

### ADDITIONAL U.S. REGULATIONS (continued):

**RELEASES CLEAN AIR ACT SECTION 112(r)- Table 3 to §68.130:** Propane and Pentane are listed under this regulation in Table 3 as a Regulated Substances (Flammable Substances), in quantities of 10,000 lb (4,540 kg) or greater. Hexane is listed as a Hazardous Air Pollutant (HAP) generally known or suspected to cause serious health problems under the Clean Air Act.

**U.S. OSHA HIGHLY HAZARDOUS CHEMICALS (HHCS):** Code of Federal Regulations (CFR) v.29 Part 1910, Section 1910.119, July 1, 1997. The Nitrogen Dioxide component has a reportable quantity under this regulation of 1500 lb (681 kg).

### OTHER U.S. FEDERAL REGULATIONS:

- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR Part 82).

**CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65):** The Carbon Monoxide component of this gas mixture is on the California Proposition 65 lists. **WARNING!** This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

### ADDITIONAL CANADIAN REGULATIONS:

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

**CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS:** The components of this gas mixture are on the CEPA Priorities Substances Lists, as follows:

**Carbon Monoxide:** This is a National Pollutant Release Inventory (NPRI) substance for 2007. Information about this substance must be reported to the Minister of the Environment in accordance with subsection 46(1) of the Canadian Environmental Protection Act, 1999. This substance is listed under PART 4, CRITERIA AIR CONTAMINANTS CACs).

**GREENHOUSE GASES KYOTO PROTOCOL:** Not applicable.

**CANADIAN WHMIS REGULATIONS:** This gas mixture is categorized as a Controlled Product, Hazard Classes A, D2A and D2B, as per the Controlled Product Regulations.

**CANADIAN WHMIS SYMBOLS:**



## 16. OTHER INFORMATION

### INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Non-flammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. Calgas will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

**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 produce 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 about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 421 Walney Road, 5<sup>th</sup> Floor, Chantilly, VA 20151. Telephone: (703) 788-2700, Fax: (703) 961-1831.

*P-1 "Safe Handling of Compressed Gases in Containers"*

*AV-1 "Safe Handling and Storage of Compressed Gases"*

*"Handbook of Compressed Gases"*

### PREPARED BY:

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Fax on Demand: 1-800/231-1366



This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this gas mixture. To the best of Calgas' knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this gas mixture is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.