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MATERIAL SAFETY DATA SHEET

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

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE

Containing the Following Components in a Nitrogen Balance Gas:
Hydrogen Sulfide 0.001-0.025%, Pentane 0.0-0.75%, Carbon Monoxide 0.0-1.0%, Oxygen 0.0015-23.5%, Carbon Dioxide 0.005-50.0%

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: 50119 (Replaces ISC MSDS No. 1810-7995, 1810-9182)

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.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
U.S. SUPPLIER/MANUFACTURER'S NAME:	CALGAZ
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
BUSINESS PHONE:	1-410-228-6400 (8 a.m. to 5 p.m. U.S. EST)
General MSDS Information**:**	1-713-868-0440
Fax on Demand:	1-800-231-1366
EMERGENCY PHONE:	
Chemtrec: United States/Canada/Puerto Rico:	1-800-424-9300 [24-hours]
Chemtrec International:	1-703-527-3887 [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 gas mixture is colorless and has an odor of rotten eggs or sulfur. **Health Hazards:** This gas mixture may cause adverse health effects due to the presence of Hydrogen Sulfide, Carbon Monoxide and Carbon Dioxide, 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
Hydrogen Sulfide	H_2S	7783-06-4	0.001-0.025%
Pentane	C_5H_{12}	109-66-0	0.0-0.75%
Carbon Monoxide	CO	630-08-0	0.0005-1.0%
Oxygen	O_2	7782-44-7	0.0015-23.5%
Carbon Dioxide	CO_2	124-38-9	0.0005-50.0%
Nitrogen	N_2	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: None known.

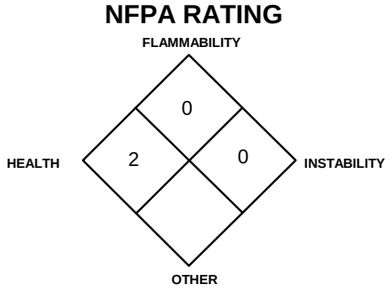
UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

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.

NFPA RATING



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							
		ACGIH-TLVs		OSHA-PELs		NIOSH-RELs		NIOSH	OTHER
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	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
Carbon Dioxide	124-38-9	5000	30,000	5000 10,000 (Vacated 1989 PEL)	30,000 (Vacated 1989 PEL)	5000	30,000	40,000	DFG MAKs: TWA = 5000 PEAK = 2•MAK 15 min. average value, 1-hr interval, 4-per shift
Hydrogen Sulfide	7783-06-4	1	5	10 (Vacated 1989 PEL)	20 (ceiling); 50 (10 min. peak, once per shift) 15 (Vacated 1989 PEL)	NE	10 (ceiling) 10 min.	100	DFG MAKs: TWA = 5 PEAK = 2•MAK 15 min. average value, 1-hr interval, 4-per shift DFG MAK Pregnancy Risk Classification: C Carcinogen: EPA-I
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	1000 600 (Vacated 1989 PEL)	120 750 (Vacated 1989 PEL)	610 (ceiling) 15 min.	NE	1500 (based on 10% of LEL)	DFG MAKs: TWA = 1000 PEAK = 2•MAK 15 min. average value, 1-hr interval, 4 per shift DFG MAK Pregnancy Risk Classification: C
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). The following are NIOSH Respiratory Protective Equipment Guidelines for the toxic components of this gas mixture, Hydrogen Sulfide, Carbon Dioxide and Carbon Monoxide:

CARBON DIOXIDE

CONCENTRATION	RESPIRATORY PROTECTION
Up to 40,000 ppm:	Any Supplied-Air Respirator (SAR), or any Self-Contained Breathing Apparatus (SCBA) with a full facepiece.
Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions:	Any Self-Contained Breathing Apparatus 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.

CARBON MONOXIDE

CONCENTRATION	RESPIRATORY PROTECTION
Up to 350 ppm:	Any Supplied-Air Respirator (SAR).
Up to 875 ppm:	Any SAR operated in a continuous-flow mode.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued):

CARBON MONOXIDE (continued)

Up to 1200 ppm: 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.

HYDROGEN SULFIDE

CONCENTRATION	RESPIRATORY PROTECTION
Up to 100 ppm:	Any Powered, Air-Purifying Respirator (PAPR) with cartridge(s), or any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted canister, or any Supplied-Air Respirator (SAR), Self-Contained Breathing Apparatus 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 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, or 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 Carbon Dioxide, a possible main component of this gas mixture.

GAS DENSITY @ 21.1°C and 1 atm: 0.1144 lb/ft^3 (1.833 kg/m^3)

MOLECULAR WEIGHT: 44.01

SUBLIMATION POINT: -78.5°C (-109.3°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C: 1.522

ODOR THRESHOLD: Odorless.

EXPANSION RATIO: Not applicable.

EVAPORATION RATE (nBuAc = 1): Not applicable.

SPECIFIC VOLUME (ft^3/lb): 8.76

VAPOR PRESSURE @ 21.1°C: 838 psig (5778 kPa)

SOLUBILITY IN WATER vol/vol 20°C and 1 atm: 0.90

LIQUID DENSITY @ 21.1°C and 838 psig (5778 kPa): 47.35 lb/ft^3 (761.3 kg/m^3)

FREEZING/MELTING POINT: (sublimation temperature) -78.5°C (-109.3°F)

TRIPLE POINT: -55.6°C (-69.9°F) @ 60.4 psig (416 kPa)

pH: 3.7 at 1 atm (form carbonic acid)

The following information is for Nitrogen, a main component of this gas mixture.

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

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

BOILING POINT: -320.4°F (-195.8°C)

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

pH: Not applicable.

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

MOLECULAR WEIGHT: 28.01

EVAPORATION RATE (nBuAc = 1): Not applicable.

EXPANSION RATIO: Not applicable.

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

SPECIFIC VOLUME (ft^3/lb): 13.8

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for this gas mixture.

ODOR THRESHOLD: For Hydrogen Sulfide: 0.13 ppm.

APPEARANCE, ODOR and COLOR: This is a colorless gas mixture with a rotting egg or sulfurous odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor cannot be relied upon as a method of identifying release of this gas mixture as continued low-level inhalation can cause olfactory fatigue, due to the presence of Hydrogen Sulfide. 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. Wet lead acetate paper can also be used for leak detection. The paper turns black in the presence of Hydrogen Sulfide. Cadmium solutions will turn yellow upon contact with Hydrogen Sulfide.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

DECOMPOSITION PRODUCTS: *Combustion:* Sulfur oxides, carbon oxides. *Hydrolysis:* None known.

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. The Carbon Dioxide component may cause this gas mixture to be incompatible with acrolein or aziridine, magnesium, titanium, zirconium or magnesium-aluminum alloy dusts, lithium or sodium, metal hydrides (e.g. aluminum hydride) or aluminum, chromium or manganese dusts sodium peroxide and aluminum or magnesium or tin powders, diethyl magnesium, cesium oxide, monolithium acetylide-ammonia or rubidium acetylide, powdered metals and nitrogen (e.g. beryllium, cerium and alloys, thorium, uranium, titanium and zirconium) - ignite on heating in mixtures of carbon dioxide and nitrogen. Due to the presence of Hydrogen Sulfide, this gas mixture may be incompatible with strong oxidizers. Hydrogen Sulfide is corrosive to most metals due to reaction with metals to form metal sulfides. The Carbon Monoxide component is mildly corrosive to nickel and iron (especially at high temperature and pressure).

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, Carbon Dioxide and Hydrogen Sulfide components of this gas mixture, which can reach exposure limits at the levels present in the mixture. Inhalation of high concentrations of Hydrogen Sulfide can cause dizziness, headache, and nausea. Exposure to higher concentrations can result in respiratory arrest, coma, or unconsciousness. Exposure for more than 30 minutes at concentrations of greater than 600 ppm has been fatal. Continuous inhalation of low concentrations may cause olfactory fatigue, so that the odor is no longer an effective warning of the presence of Hydrogen Sulfide. Severe exposures which do not result in death may cause long-term symptoms such as memory loss, paralysis of facial muscles, or nerve tissue damage. 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.

INHALATION (continued): 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 Carbon Dioxide, inhalation may result in increased breathing rate, and headache and tiredness upon prolonged exposure. Such exposure may occur if the mixture is released in a small, poorly ventilated area (i.e. an enclosed or confined space.

Another significant health hazard associated with this gas mixture is when this gas mixture 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	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

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.

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

CONTACT WITH SKIN or EYES: The gas may be irritating to the skin. Contact with rapidly expanding gases (which are released under high pressure) may cause frostbite. Due to presence Hydrogen Sulfide inflammation and irritation of the eyes can occur at very low airborne concentration (less than 10 ppm). Exposure over several hours may result in “gas eyes” or “sore eyes” with symptoms of scratchiness, irritation, tearing and burning. Above 50 ppm, there is an intense tearing, blurring of vision, and pain when looking at light. Exposed individuals may see rings around bright lights. Most symptoms disappear when exposure ceases. However, in serious cases, the eye can be permanently damaged. Due to the presence of Carbon Dioxide, prolonged contact of high concentrations with the eyes may cause damage to the retinal ganglion cells.

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 Hydrogen Sulfide 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 and eyes may be irritating. A sudden release of pressure from the cylinder may cause frostbite to exposed tissues.

CHRONIC: Chronic low-level exposure to the eyes may result in damage to eyes from contact with Hydrogen Sulfide and/or Carbon Dioxide. 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. Additionally, long-term exposure to Pentane can adversely affect the peripheral nervous system.

TARGET ORGANS: ACUTE: Respiratory system, central nervous system. CHRONIC: Skin, heart, 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 DIOXIDE:

LCLo (Inhalation-Human) 9 pph/5 minutes
LCLo (Inhalation-Mammal-species unspecified) 90000 ppm/5 minutes
TCLo (Inhalation-Rat) 10000 ppm/24 hours/days-continuous: Blood: other changes
TCLo (Inhalation-Rat) 6 pph/24 hours: female 10 day(s) after conception: Reproductive: Specific Developmental Abnormalities: musculoskeletal system, cardiovascular (circulatory) system, respiratory system
TCLo (Inhalation-Rat) 6 pph/24 hours: female 10 day(s) after conception: Reproductive: Effects on Newborn: growth statistics (e.g.%, reduced weight gain)
TCLo (Inhalation-Rabbit) 13 pph/4 hours: female 9-12 day(s) after conception: Reproductive: Specific Developmental Abnormalities: musculoskeletal system
TCLo (Inhalation-Rabbit) 27,000 ppm/24 hours/30 days-continuous: Behavioral: somnolence (general depressed activity)
TCLo (Inhalation-Mouse) 55 pph/2 hours: male 3 day(s) pre-mating: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count)
TCLo (Inhalation-Mouse) 55 pph/4 hours: male 6 day(s) pre-mating: Reproductive: Fertility: male fertility index (e.g. # males impregnating females per # males exposed to fertile non-pregnant females)
TCLo (Inhalation-Mouse) 2 pph/8 hours: female 10 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

CARBON MONOXIDE:

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

CARBON MONOXIDE (continued):

TCLo (Inhalation-Human) 50 mg/m^3/5 hours: Behavioral: changes in psychophysiological tests
TCLo (Inhalation-Human) 55 mg/m^3/8 hours: Sense Organs and Special Senses (Eye): effect, not otherwise specified
TCLo (Inhalation-Human) 60 mg/m^3/6 hours: Cardiac: pulse rate Brain and Coverings: changes in surface EEG
TCLo (Inhalation-Human) 80 mg/m^3/3 hours: Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: changes in psychophysiological tests; Behavioral: ataxia
TCLo (Inhalation-Human) 220 mg/m^3/1 hour: Behavioral: headache
TCLo (Inhalation-Human) 220 mg/m^3/3 hours: Behavioral: somnolence (general depressed activity)
TCLo (Inhalation-Human) 230 mg/m^3/6 hours: Brain and Coverings: increased intracranial pressure; Behavioral: somnolence (general depressed activity)
TCLo (Inhalation-Human) 440 mg/m^3/4 hours: Behavioral: headache; Gastrointestinal: nausea or vomiting
TCLo (Inhalation-Human) 440 mg/m^3/1 hour: Behavioral: headache; Cardiac: pulse rate increase, without fall in BP
TCLo (Inhalation-Human) 460 mg/m^3/4 hours: Behavioral: headache, somnolence (general depressed activity); Vascular: BP lowering not characterized in autonomic section
TCLo (Inhalation-Human) 660 mg/m^3/2 hours: Gastrointestinal: nausea or vomiting
TCLo (Inhalation-Human) 660 mg/m^3/4 hours: Behavioral: general anesthetic
TCLo (Inhalation-Human) 800 mg/m^3/5 minutes: Behavioral: headache, somnolence (general depressed activity)
TCLo (Inhalation-Human) 800 mg/m^3/20 minutes: Gastrointestinal: nausea or vomiting; Behavioral: muscle weakness
TCLo (Inhalation-Human) 800 mg/m^3/3 hours: Cardiac: pulse rate increase, without fall in BP; Vascular: BP lowering not characterized in autonomic section
TCLo (Inhalation-Human) 880 mg/m^3/2 hours: Behavioral: somnolence (general depressed activity), general anesthetic; Vascular: BP lowering not characterized in autonomic section
TCLo (Inhalation-Human) 880 mg/m^3/4 hours: Behavioral: tetany, coma
TCLo (Inhalation-Human) 1260 mg/m^3/90 minutes: Cardiac: pulse rate increase, without fall in BP; Behavioral: coma, tetany
TCLo (Inhalation-Human) 1300 mg/m^3/2 hours: Gastrointestinal: nausea or vomiting; Cardiac: pulse rate increase, without fall in BP; Behavioral: headache
TCLo (Inhalation-Human) 1350 mg/m^3/33 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^3/20 minutes: Behavioral: headache; Gastrointestinal: nausea or vomiting
TCLo (Inhalation-Human) 1760 mg/m^3/2 hours: Behavioral: general anesthetic; Vascular: BP lowering not characterized in autonomic section
TCLo (Inhalation-Human) 1800 mg/m^3/1 hour: Lungs, Thorax, or Respiration: respiratory depression; Cardiac: change in force of contraction
TCLo (Inhalation-Human) 2000 mg/m^3/12 minutes: Behavioral: tetany, coma
TCLo (Inhalation-Human) 3000 mg/m^3/1 hour

TOXICITY DATA (continued):

CARBON MONOXIDE (continued):

TCLo (Inhalation-Human) 2300 mg/m^3/30 minutes: Behavioral: general anesthetic; Vascular: BP lowering not characterized in autonomic section
TCLo (Inhalation-Human) 3520 mg/m^3/30 minutes: Behavioral: general anesthetic; Gastrointestinal: nausea or vomiting
TCLo (Inhalation-Human) 5000 mg/m^3/17 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_{50} (Inhalation-Rat) 1807 ppm/4 hours
LC_{50} (Inhalation-Rat) 1900 mg/m^3/4 hours
LC_{50} (Inhalation-Rat) 13,500 mg/m^3/15 minutes
LC_{50} (Inhalation-Rat) 6600 ppm/30 minutes
LC_{30} (Inhalation-Rat) 24,000 ppm/5 minutes: Lungs, Thorax, or Respiration: respiratory obstruction; Blood: other changes; Nutritional and Gross Metabolic: metabolic acidosis
LC_{50} (Inhalation-Mouse) 2444 ppm/4 hours
LC_{50} (Inhalation-Mouse) 2230 mg/m^3/2 hours
LC_{50} (Inhalation-Guinea Pig) 5718 ppm/4 hours
LC_{50} (Inhalation-Bird-Wild Bird Species) 1334 ppm
LC (Inhalation-Rat) 5200 mg/m^3/1 hour
LC (Inhalation-Mouse) 1900 mg/m^3/2 hours
LCLo (Inhalation-Dog) 4000 ppm/46 minutes
LCLo (Inhalation-Rabbit) 4000 ppm
LCLo (Inhalation-Rabbit) 17,200 mg/m^3/40 minutes
LCLo (Inhalation-Rabbit) 20,000 mg/m^3/60 minutes
LCLo (Inhalation-Cat) 500 mg/m^3/30 minutes
LCLo (Inhalation-Cat) 34,400 mg/m^3/3 minutes
LCLo (Inhalation-Dog) 23,000 mg/m^3/20 minutes
LCLo (Inhalation-Guinea Pig) 4600 mg/m^3/2 hours
LCLo (Inhalation-Guinea Pig) 10,300 mg/m^3/60 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^3/4 hours: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)
TCLo (Inhalation-Rat) 88 mg/m^3/20 minutes: Nutritional and Gross Metabolic: changes in phosphorus
TCLo (Inhalation-Rat) 176 mg/m^3/20 minutes: Brain and Coverings: other degenerative changes
TCLo (Inhalation-Rat) 800 mg/m^3/4 hours: Behavioral: altered sleep time (including change in righting reflex)
TCLo (Inhalation-Rat) 2000 mg/m^3/11 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^3/5 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^3/4 hours/10 weeks-intermittent: Brain and Coverings: other degenerative changes; Cardiac; other changes; Endocrine: other changes
TCLo (Inhalation-Rat) 53 mg/m^3/30 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^3/1 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
TCLo (Inhalation-Rat) 1 mg/m^3/24 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 1-22 day(s) after conception: Reproductive: Effects on Newborn: growth statistics (e.g.%, reduced weight gain), behavioral
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-Rat) 103 mg/m^3: 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)

CARBON MONOXIDE (continued):

TCLo (Inhalation-Rat) 100 mg/m^3/2 hours: Peripheral Nerve and Sensation: recording from peripheral motor nerve
TCLo (Inhalation-Rat) 150 ppm: female 1-20 day(s) after conception: Reproductive: Specific Developmental Abnormalities: Central Nervous System
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-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/m3/4 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^3: 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^3/60 minutes: 50 mg/m^3/60 minutes: Behavioral: alteration of classical conditioning
TCLo (Inhalation-Cat) 2000 mg/m^3/20 minutes: Behavioral: alteration of classical conditioning
TCLo (Inhalation-Dog) 2000 mg/m^3/30 minutes: Behavioral: alteration of classical conditioning
TCLo (Inhalation-Guinea Pig) 2000 mg/m^3/30 minutes: Behavioral: alteration of classical conditioning
TCLo (Inhalation-Guinea Pig) 200 mg/m^3/5 hours/4 weeks-intermittent: Endocrine: hyperglycemia
TCLo (Inhalation-Guinea Pig) 200 mg/m^3/5 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/m3/10weeks-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^3: 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^3: 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^3: 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^3: 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^3/10 minutes: Lungs, Thorax, or Respiration: acute pulmonary edema
TCLo (Inhalation-Monkey) 1145 mg/m^3/30 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^3/90 days-intermittent: Cardiac: other changes
TCLo (Inhalation-Rabbit) 200 mg/m^3/3 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^3/1 year-intermittent: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol)
TCLo (Inhalation-Rabbit) 170 mg/m^3/45 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
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

11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):

CARBON MONOXIDE (continued):
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
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

CARBON MONOXIDE (continued):
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

CARBON MONOXIDE (continued):
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:

Hydrogen Sulfide: EPA-I (Data are Inadequate for an Assessment of Human Carcinogenic Potential);

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 Hydrogen Sulfide, skin contact may cause irritation. Due to the presence of Carbon Dioxide, eye contact may cause irritation. Contact with rapidly expanding gases can be irritating to exposed skin and eyes.

SENSITIZATION TO THE PRODUCT: The Pentane component is a weak cardiac sensitizer of the dog heart to epinephrine.

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.

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. The developmental effects of the Carbon Dioxide component have been evaluated in several studies. All of the studies had deficiencies with respect to experimental design and reporting or involved exposures which would most certainly have produced maternal toxicity; therefore, it is not possible to draw any conclusions regarding teratogenicity or embryotoxicity. In one study, rats were exposed to 6% Carbon Dioxide for one 24-hour period on the single days of pregnancy (days 5-21). The incidence of cardiac malformations was higher in the offspring of treated animals than in the control group, particularly when exposure was on the tenth day of pregnancy. There was also an increased incidence of skeletal malformations and stillborn pups in the exposure groups. In another study, rabbits, exposed to 8% Carbon Dioxide on days 21-28 of pregnancy, had offspring with decreased body weight and an increased occurrence of advanced lung maturation, an effect which may not be harmful. Both of these studies lacked reporting on 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. No conclusions can be made from two studies on the effect of the Carbon Dioxide component on the male rodent reproductive system. In one study, sperm shape was altered and fertility decreased in male mice exposed to very high levels (approximately 35%) of Carbon Dioxide and low levels of oxygen. However, the experimental design was inadequate and conclusions cannot be made. In another study, male rats were exposed to 2.5%, 5.0% or 10% Carbon Dioxide for 1, 2, 4 or 8 hours. Reversible dose- and time-dependent degenerative changes were observed in the testes.

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	• End of shift	• 3.5% of Hemoglobin
• Carboxyhemoglobin in end-exhaled air	• End of shift	• 20 ppm

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 Hydrogen Sulfide.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Due to the presence of Hydrogen Sulfide in this mixture, release near an aquatic environment may cause harm. The following aquatic toxicity data are currently available for Carbon Dioxide and Hydrogen Sulfide:

CARBON DIOXIDE:
Lethal Toxic Effect (Trout) 1 hour = 240 mg/L
Lethal Toxic Effect (Rainbow trout) 96 hours = 35 mg/L
Lethal Toxic Effect (Rainbow trout) 12 hours = 60-240 mg/L
Harmful to some species of aquatic life in concentrations less than 20 mg/L

HYDROGEN SULFIDE:
LC_{50} (Fly inhalation) > 960 minutes = 380 mg/cu m
LC_{50} (Fly inhalation) 7 minutes = 1500 mg/cum
TLm (*Asellus sp*) 96 hours = 0.111 mg/L/Conditions of bioassay not specified
TLm (*Crangonyx sp*) 96 hours = 1.07 mg/L/Conditions of bioassay not specified
TLm (*Gammarus sp*) 96 hours = 0.84 mg/L/Conditions of bioassay not specified

HYDROGEN SULFIDE (continued):
TLm (*Lepomis macrochirus* bluegill sunfish eggs) 72 hours = 0.0190 mg/L at 21-22°C in a flow through bioassay
TLm (*Lepomis macrochirus* bluegill sunfish) 96 hours = 35 day old fry 0.0131 mg/L at 21-22°C in a flow through bioassay
TLm (*Lepomis macrochirus* bluegill sunfish) 96 hours = juveniles 0.0478 mg/L at 21-22°C in a flow through bioassay
TLm (*Lepomis macrochirus* bluegill sunfish adults) 96 hours = 0.0448 mg/L at 21-22°C in a flow through bioassay
TLm (*Pimephales promelas* fathead minnow) 96 hours = 0.0071-0.55 mg/L at 6-24°C in a flow through bioassay
TLm (*Salvelinus fontinalis* brook trout) 96 hours = 0.0216-0.038 mg/L at 8-12.5°C in a flow through bioassay

MOBILITY: Nitrogen is inert and does not present a hazard of mobility. Anhydrous Hydrogen Sulfide has a boiling point of 60.3°C at 1 atm. Consequently, when it is spilled onto soil, much will evaporate. However, since it is very soluble in water, the presence of water in soil or falling as precipitation at the time of the spill may contribute to movement in the soil. If the soil surface is saturated with moisture at the time of the spill as might be the case after a rainfall, the spill chemical will runoff and/or evaporate away. Using a structure estimation method based on molecular connectivity indices, the Koc for n-Pentane can be estimated to be 80. According to a classification scheme, this estimated Koc value suggests that n-pentane is expected to have high mobility in soil.

12. ECOLOGICAL INFORMATION (Continued)

PERSISTENCE AND BIODEGRADABILITY: Persistence: Nitrogen is a natural element and presents no hazard of persistence. If released to air, a vapor pressure of 514 mm Hg at 25°C indicates n-Pentane will exist solely as a vapor in the ambient atmosphere. Vapor-phase n-Pentane will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 4 days. If released to soil, n-Pentane 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. n-Pentane may volatilize from dry soil surfaces based upon its vapor pressure. Screening studies suggest that n-Pentane will undergo biodegradation in soil and water surfaces, but volatilization is expected to be the predominant fate process in the environment. If released into water, n-pentane is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 1 hour and 3 days, respectively. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. The lifetime of the Hydrogen Sulfide component is affected by ambient temperature and other atmospheric variables including humidity, sunshine, and presence of other pollutants. Once released into the atmosphere, Hydrogen Sulfide will behave like many other gaseous pollutants and be dispersed and eventually removed. Residence times in the atmosphere range from about one day to more than 40 days, depending upon season, latitude, and atmospheric conditions. Biodegradation: Nitrogen does not biodegrade. Microorganisms in soil and water are involved in oxidation-reduction reactions which oxidize the Hydrogen Sulfide component to elemental sulfur. Members of the genera Beggiatoa, Thioploca, and Thiotrix function in transition zones between aerobic and anaerobic conditions where both molecular oxygen and Hydrogen Sulfide are found. Also some photosynthetic bacteria oxidize Hydrogen Sulfide to elemental sulfur. Members of the families Chlorobiaceae and Chromatiaceae (purple sulfur bacteria) are obligate aerobes and are phototropic, and are found in waters with high H_2S concentrations. The interactions of these organisms form part of the global sulfur cycle.

POTENTIAL TO BIOACCUMULATE: The Nitrogen and Carbon Dioxide components of this gas mixture will not bioaccumulate. The Hydrogen Sulfide component does not have bioaccumulation or food chain contamination potential. An estimated BCF of 80 was calculated for n-Pentane, 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.

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_3) and Hydroxide Ion (OH^-) to changes in Methane (CH_4), Carbon Monoxide (CO), and Nitric Oxide (NO) emissions and to perturbations in climate and stratospheric chemistry. In most cases, increased CH_4 and CO emissions will suppress OH^- (negative coefficients) in increased O_3 (positive coefficients) except in areas where NO and O_3 influenced by pollution are sufficient to increased OH^-. In most regions, NO, CO, and CH_4 emission increase will suppress OH^- and increase O_3, but these trends may be opposed by stratospheric O_3 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 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, Carbon Dioxide)
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 (2004): 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 (outer package). Pertinent shipping information goes on the outside of the outer package. 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, Carbon Dioxide)
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 (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).

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, Carbon Dioxide)
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 MAXIUMUM NET QUANTITY/PKG: None
PASSENGER & CARGO AIRCRAFT PACKING INSTRUCTION: 200
PASSENGER & CARGO AIRCRAFT MAXIUMUM NET QUANTITY/PKG: 75 kg
CARGO AIRCRAFT ONLY PACKING INSTRUCTION: 200
CARGO AIRCRAFT ONLY MAXIUMUM 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)
Hydrogen Sulfide	Yes	Yes	Stayed Chemical

U.S. SARA 302 EXTREMELY HAZARDOUS THRESHOLD PLANNING QUANTITY (TPQ): Hydrogen Sulfide = 500 lb (227 kg)

U.S. SARA 304 EXTREMELY HAZARDOUS REPORTABLE QUANTITY (RQ): Hydrogen Sulfide = 100 lb (45.4 kg)

U.S. CERCLA REPORTABLE QUANTITY (RQ): Hydrogen Sulfide = 100 lb (45.4 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: Code of Federal Regulations 40 CFR 116 & 117 (01 Jul 2002). Under the provisions of Section 311 of the Clean Water Act, Hydrogen Sulfide is designated a hazardous substance if discharged in navigable waters. The Reportable Quantity (RQ) for notification is 100 lb (45.4 kg).

U.S. EPA LIST OF REGULATED TOXIC SUBSTANCES AND THRESHOLD QUANTITIES FOR ACCIDENTAL RELEASE PREVENTION- Table 1 to §68.130: Under this regulation, the Threshold Quantity (TQ) for Hydrogen Sulfide is 10,000 lb (4540 kg). The basis for listing is a) mandated by Congress and b) the gas is on the EHS list with a vapor pressure of 10 mmHg or greater.

U.S. EPA REGULATED SUBSTANCES, PER 40 CFR, PART 68, OF THE RISK MANAGEMENT FOR CHEMICAL RELEASES CLEAN AIR ACT SECTION 112(r)- Table 3 to §68.130: Pentane is listed under this regulation in Table 3 as a Regulated Substance (Flammable Substance), in quantities of 10,000 lb (4,540 kg) or greater.

U.S. OSHA HIGHLY HAZARDOUS CHEMICALS (HHCS): Code of Federal Regulations (CFR) v.29 Part 1910, Section 1910.119, July 1, 1997. The Hydrogen Sulfide 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/NDSL 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).

Hydrogen Sulfide: 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 1, GROUP 1 SUBSTANCES.

GREENHOUSE GASES KYOTO PROTOCOL: Carbon Dioxide is listed under Schedule 1: Greenhouse Gases. Table 1: Greenhouse Gases Subject to Mandatory Reporting. Table 2: Details of Greenhouse Gases and Global Warming Potentials (GWPs). 100 year GWP: 1;

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. Calgaz 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, 5th 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"

AIR LIQUIDE

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 CALGAZ 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.