



MATERIAL SAFETY DATA SHEET

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

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: 0-30% CARBON DIOXIDE IN HELIUM (0-99%), NITROGEN (0-99%), or XENON (0-99%)

PRODUCT USE: Laser Gas

MANUFACTURER:

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Branchburg, NJ 08876, U.S.A.

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SPECTRA GASES EMERGENCY CONTACT: 800/932-0624 8:30 AM - 7:00 PM (EST)

24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 703/527-3887

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

EU LABELING/CLASSIFICATION: This gas mixture is classified per the European Union Council Directives. The following is a self-classification.

EU Classification: Xi [Irritant]

EU Risk Phrases: R: 36 [Irritating to eyes.]

Chemical Name	Chemical Synonyms	Chemical Formula	CAS #	EINECS #	% Composition	EU Classification For Components
Carbon Dioxide	Carbonic acid anhydride; Carbonic acid gas; Carbonic anhydride; Carbon oxide; CO ₂	CO ₂	124-38-9	204-696-9	0-30%	SELF-CLASSIFICATION HAZARD CLASSIFICATION: Xi [Irritant] RISK PHRASES: R: 36 [Irritating to eyes.]
Helium	None	He	7440-59-7	231-168-5	0-99%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable
Nitrogen	None	N ₂	7727-37-9	231-783-9	0-99%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable
Xenon	None	Xn	7440-63-3	231-172-7	0-99%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Product Description: This is a colorless, odorless, non-flammable gas mixture, shipped under pressure. **Health Hazards:** This gas mixture may produce significant, adverse health effects at relatively low concentrations, due to the presence of Carbon Dioxide. Inhalation of Carbon Dioxide can increase respiration and heart rate (possibly resulting in circulatory insufficiency) and cause nausea, dizziness, headache, mental confusion. Severe inhalation overexposures can be fatal, due to the effects of Carbon Dioxide and oxygen deficiency. High levels of Carbon Dioxide can also cause eye irritation. **Flammability Hazards:** This gas mixture is not flammable. **Reactivity Hazards:** This gas mixture is not reactive. **Environmental Hazards:** Release of this product to the environment may cause environmental harm. **Emergency Response Considerations:** 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 toxic levels of Carbon Dioxide or a low level of Oxygen, they should be equipped with Self-Contained Breathing Apparatus (SCBA).

HMIS RATINGS: HEALTH HAZARD: = 1; FLAMMABILITY HAZARD: = 0; PHYSICAL HAZARD: = 0

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING - If rescue personnel need to enter an area suspected of having a toxic level of Carbon Dioxide, they should be equipped with Self-Contained Breathing Apparatus (SCBA), and, if available, a full-body chemically resistant suit. Acute overexposure to this gas mixture may cause the following health effects:

EYE CONTACT: Due to the possible presence of Carbon Dioxide, eye exposure to this gas mixture may cause mild to moderate eye irritation with symptoms such as pain, redness, and tearing. High-pressure release may result in airborne objects.

SECTION 3. HAZARD IDENTIFICATION (Continued)

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

INHALATION: This gas mixture can produce significant, adverse health effects at relatively low concentrations, due to the presence of Carbon Dioxide. Carbon Dioxide is an asphyxiant and a powerful cerebral vasodilator. If the concentration of Carbon Dioxide reaches 10% or more, suffocation can occur within minutes. If inhaled at concentrations between 2-10%, Carbon Dioxide can cause nausea, dizziness, headache, mental confusion, increased blood pressure and respiratory rate. Carbon Dioxide initially stimulates respiration and then causes respiratory depression. Repeated inhalation of low concentrations (3-5%) have no known permanent harmful effects. If this gas mixture is inhaled, symptoms from exposure Carbon Dioxide which may develop include those described below.

**CONCENTRATION
of CARBON DIOXIDE**

EXPOSURE SYMPTOM

1%	Slight increase in breathing rate.
2%	Breathing rate increases to 50% above normal level. Prolonged exposure can cause headache, tiredness.
3%	Breathing increases to twice normal rate and becomes labored. Weak narcotic effect. Impaired hearing, headache, increase in blood pressure and pulse rate.
4-5%	Breathing increases to approximately four times normal rate, symptoms of intoxication become evident and slight choking may be felt.
5-10%	Characteristic sharp odor noticeable. Very labored breathing, headache, visual impairment and ringing in the ears. Judgment may be impaired, followed within minutes by loss of consciousness.
50-100%	Unconsciousness occurs more rapidly above 10% level. Prolonged exposure to high concentrations may eventually result in death from asphyxiation.

An additional health hazard associated with this gas mixture is asphyxiation after inhalation of oxygen-deficient environments. If large volumes of this gas mixture are released or if this gas mixture is released in poorly-ventilated areas (i.e., enclosed or confined spaces), an oxygen-deficient environment may occur. It should be noted that before adverse health effects or suffocation could occur, the effects of overexposure to Carbon Dioxide will be felt. Individuals breathing an oxygen-deficient atmosphere may experience symptoms that include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. The following effects associated with various levels of oxygen are as follows:

**CONCENTRATION
of OXYGEN**

EXPOSURE SYMPTOM

20.9% Oxygen:	Normal oxygen concentration in air.
15-19% Oxygen:	Decreased ability to perform tasks. May impair coordination and may induce early symptoms in persons with heart, lung, or circulatory problems.
12-15% Oxygen:	Breathing increases, especially in exertion. Pulse up. Impaired coordination, perception, and judgment.
10-12% Oxygen:	Breathing further increases in rate and depth, poor coordination and judgment, lips slightly blue.
Less than 10% Oxygen:	Mental failure, inability to perform various movements, loss of consciousness without warning, convulsions, death.

Inhalation of very high concentrations can cause the heart to beat irregularly (arrhythmia) or to stop, which can be fatal.

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

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation, eye contact.

TARGET ORGANS: Respiratory system, eyes.

SYMPTOMS: Persistent irritation may result from repeated exposure. Prolonged contact of high concentrations of Carbon Dioxide with the eyes can cause damage to the retinal ganglion cells.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing dermatitis, eye conditions and respiratory disorders may be aggravated by over-exposure to this gas mixture.

CARCINOGENICITY: The components of this gas mixture are not listed on the EPA, NIOSH, GERMAN MAK, OSHA, NTP, or CAL/OSHA Carcinogenicity lists.

SECTION 4. FIRST AID MEASURES

EYE CONTACT: In the event of mechanical injury, cover eye with bandage and seek appropriate medical attention.

INGESTION: Ingestion is an unlikely route of exposure for this material.

INHALATION: Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. In the event of severe, immediate effects or delayed symptoms which develop after exposure, victim must seek appropriate medical attention.

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

NOTES TO PHYSICIANS: Administer oxygen, if necessary and treat symptoms.

SECTION 5. FIRE FIGHTING MEASURES

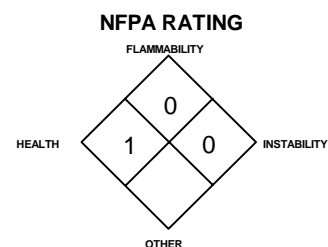
FLASH POINT: Not Applicable

AUTOIGNITION: Not Applicable

FLAMMABLE RANGE: Not Applicable

NFPA RATINGS:

HEALTH: = 1 FLAMMABILITY: = 0
INSTABILITY: = 0 SPECIAL: None.



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

SPECIAL FIRE-FIGHTING PROCEDURES: Non-flammable. Use extinguishing media appropriate for surrounding fire. In the event of fire, cool containers of this product with water spray to prevent failure.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas does not burn; however, containers, when involved in fire, may rupture or burst in the heat of the fire. Most cylinders have a pressure release device, which will vent contents if the cylinder is exposed to high temperatures.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: Not sensitive.

HAZARDOUS COMBUSTION PRODUCTS: Carbon Dioxide will produce carbon monoxide and oxygen when heated to temperatures above 1648°C (3000°F).

SECTION 6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: In the event of a release of this product, operator should close the material source if possible to do so safely. Evacuate area in the event of a significant release. Only trained personnel, wearing Self-Contained Breathing Apparatus (SCBA) should re-enter a contaminated area if oxygen levels are below 19.5% or unknown. If leak is in user's gas handling equipment or system, close cylinder valve, and safely vent high pressure before attempting repairs. If leak is from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier. The level of oxygen should be above 19.5% before personnel can be allowed in the area without SCBA. Detection systems should be available to monitor for level of oxygen.

SECTION 7. HANDLING AND STORAGE

STORAGE: Cylinders should be stored upright (with valve protection caps or plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. Consideration should be taken to install leak detection and alarm equipment for storage areas. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

HANDLING: Releases of this gas mixture can create an oxygen-deficient atmosphere. 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. Wearing contact lenses is not recommended when handling this gas.

Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body). Close valve after each use and when empty. The failure of a valve can result in violent release of the pressurized gas, creating a severe mechanical injury hazard.

Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

SECTION 7. HANDLING AND STORAGE (Continued)

HANDLING (continued): Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Relieve pressure before attempting repairs.

SPECIAL PRECAUTIONS: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this material could occur without any significant warning symptoms. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers*. Local regulations may require specific equipment for storage and use.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Forced ventilation systems for the general work area should be provided. If appropriate, install automatic monitoring equipment to detect the level of oxygen.

EXPOSURE LIMITS:

Chemical Name	CAS #	OSHA PELs ppm	ACGIH TLVs ppm	NIOSH RELs ppm	NIOSH IDLH ppm	DFG MAKs ppm	AIHA WEELs ppm
Carbon Dioxide	123-38-9	TWA = 5000 Vacated PELs: TWA = 10,000 STEL = 30,000	TWA = 5000 STEL = 30,000	TWA = 5000 STEL = 30,000	40,000	TWA = 5000 PEAK = 2•MAK, 15 min. average value, 1-hr interval	NE
Helium	7440-59-7	Simple Asphyxiant					
Nitrogen	7727-37-9	Simple Asphyxiant					
Xenon	7440-63-3	Simple Asphyxiant					

NE = Not Established

INTERNATIONAL OCCUPATIONAL EXPOSURE LIMITS: Currently the following international exposure limits are in place for the some constituents of this product. Values given may not be the most current; individual country lists should be consulted to determine most current values available.

CARBON DIOXIDE:

Australia: TWA = 5000 ppm (9000 mg/m³), STEL = 30,000 ppm, JAN 1993

Austria: MAK = 5000 ppm (9000 mg/m³), JAN 1999

Belgium: TWA = 5000 ppm (9000 mg/m³), STEL = 30,000 ppm, JAN 1993

Denmark: TWA = 5000 ppm (9000 mg/m³), JAN 1999

Finland: TWA = 5000 ppm (9000 mg/m³), JAN 1999

Germany: MAK = 5000 ppm (9000 mg/m³), JAN 1999

Hungary: STEL = 9000 mg/m³, JAN 1993

Japan: OEL = 5000 ppm (9000 mg/m³), JAN 1999

The Netherlands: MAC-TGG = 9000 mg/m³, 2003

Norway: TWA = 5000 ppm (9000 mg/m³), JAN 1999

The Philippines: TWA = 5000 ppm (9000 mg/m³), JAN 1993

Poland: MAC(TWA) = 9000 mg/m³, MAC(STEL) = 27,000 mg/m³, JAN 1999

Russia: TWA = 5000 ppm, JAN 1993

Sweden: NGV = 5000 ppm (9000 mg/m³), KTV = 10,000 ppm (18000 mg/m³), JAN 1999

Switzerland: MAK-W = 5000 ppm (9000 mg/m³), JAN 1999

Thailand: TWA = 5000 ppm (9000 mg/m³), JAN 1993

Turkey: TWA = 5000 ppm (9000 mg/m³), JAN 1993

CARBON DIOXIDE (continued):

United Kingdom: TWA = 5000 ppm (9150 mg/m³), STEL = 15,000 ppm, SEP 2000

In Argentina, Bulgaria, Colombia, Jordan, Korea, New Zealand, Singapore, Vietnam, New Zealand, Singapore, Vietnam check ACGIH TLV

HELIUM:

Australia: Asphyxiant, JAN 1993

Belgium: Asphyxiant, JAN 1993

Hungary: Asphyxiant, JAN 1993

Switzerland: Asphyxiant, JAN 1999

United Kingdom: Asphyxiant, SEP 2000

United Kingdom: TWA = 50 ppm (237 mg/m³), STEL = 100 ppm, Skin, SEP 2000

In Argentina, Bulgaria, Colombia, Jordan, Korea, New Zealand, Singapore, Vietnam, New Zealand, Singapore, Vietnam check ACGIH TLV

NITROGEN:

United Kingdom: Asphyxiant, SEP 2000

In Argentina, Bulgaria, Colombia, Jordan, Korea, New Zealand, Singapore, Vietnam, New Zealand, Singapore, Vietnam check ACGIH TLV

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, equivalent standard of Canada, or standards of EU member states. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen level is below 19.5%, or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards, standards of Canadian CSA Standard Z94.4-93, the European Standard EN 529:2005. Maintain exposure levels of components below the levels listed above.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued): The following guidelines, based on NIOSH respiratory protection recommendations, are for the Carbon Dioxide component.

CONCENTRATION of CARBON DIOXIDE

Up to 40,000 ppm:

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Escape:

Supplied Air Respirator (SAR); or full-facepiece Self-Contained Breathing Apparatus (SCBA).
Escape-type SCBA. The IDLH concentration for Carbon Dioxide is 40,000 ppm.

EYE PROTECTION: Use approved safety goggles or safety glasses, when cylinders are not closed and capped. Be aware that particles or objects propelled by high pressure gas can fly significant distances. Eyewear should be as described in U.S. OSHA 29 CFR 1910.133, the European Standard CR 13464:1999 and the Canadian CSA Standard Z94.3-M1982, *Industrial Eye and Face Protectors*.

SKIN PROTECTION: Work (such as leather) gloves are recommended when handling cylinders of this material. Wear gloves appropriate to the specific operation for which this gas mixture is used. Use triple gloves for spill response. If necessary, refer to U.S. OSHA 29 CFR 1910.138, and the European Standard CEN/TR 15419:2006, or appropriate Standards of Canada.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require use of chemically impervious clothing. Information on general protective measures can be found in U.S. OSHA 29 CFR 1910.136, or the European Standard CEN/TR 15419:2006. 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-M1984, *Protective Footwear*.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

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

LIQUID DENSITY @ 21.1°C (70°F) and 838 psig (5778 kPa): 47.35 lb/ft³ (761.3 kg/m³)

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

SUBLIMATION POINT: -78.5°C (-109.3°F)

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

SPECIFIC GRAVITY @ 21.1°C (70°F) and 1 atm: 1.522

MOLECULAR WEIGHT: 44.01

SOLUBILITY IN WATER vol/vol 20°C (68°F) and 1 atm

EXPANSION RATIO: Not applicable.

EVAPORATION RATE (nBuAc = 1): Not applicable.

SPECIFIC VOLUME (ft³/lb): 8.76

ODOR THRESHOLD: 74,000ppm

VAPOR PRESSURE: 838 psig (5778 kPa)

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable. **pH:** 3.7 at 1 atm (from carbonic acid)

CRITICAL PRESSURE: 1070.6 psia (73829 kPa abs)

The following information is for inert components that may be part of this mixture:

	Helium	Nitrogen	Xenon
Molecular Weight	4.0	28.01	131.3
Gas Density @ 21.1°C (70°F)	0.0103 lb./ft ³ (0.165 kg/m ³)	0.072 lb./ft ³ (1.153 kg/m ³)	0.3416 lbs ft ³ (5.472 kg/m ³)
Boiling Point @ 1 atm	-268.9°C (-452.1°F)	-195.8°C (-320.4°F)	-108.2°C (-162.6°F)
Freezing/Melting Point @ 1 atm	None	-210°C (-345.8°F)	-168°F (-111°C)
Specific Gravity (air = 1) @ 21.1°C (70°F)	1.38	0.906	4.560
Solubility in Water vol/vol at 0°C (32°F) and 1 atm	0.094	0.023	0.108
Specific Volume @ 21.1°C (70°F)	97.09 lb./ft ³ (6.061 m ³ /kg)	13.8 lb/ft ³ (0.867 m ³ /kg)	2.927 ft ³ /lb (0.183 m ³ /kg)
Critical Pressure	33.0 psia (227 kPa abs)	492.9 psia (3399 kPa abs)	847.0 psia (5840 kPa abs)
Odor Threshold	odorless	odorless	odorless

The following information is for this gas mixture.

APPEARANCE, ODOR AND STATE: This gas mixture is a colorless and essentially odorless gas mixture .

WARNING PROPERTIES FOR THIS MATERIAL: There are no distinct warning properties. Monitoring for levels of Carbon Dioxide and oxygen deficiency are recommended.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: This gas mixture is stable at normal temperature and pressure.

CONDITIONS TO AVOID: Cylinders should not be exposed to temperatures in excess of 125°F (52°C); avoid exposure to incompatible materials.

MATERIALS WITH WHICH MATERIAL IS INCOMPATIBLE: This gas mixture is incompatible with powdered metals (e.g., beryllium, cerium and alloys, thorium, titanium) due to the presence of Carbon Dioxide. The Helium, Nitrogen and Xenon components of this gas mixture are inert.

SECTION 10. STABILITY AND REACTIVITY (Continued)

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Carbon Dioxide will react with alkaline materials to form carbonates and bicarbonates. In addition, in the presence of ultraviolet light or electrical discharge, Carbon Dioxide decomposes to carbon monoxide and oxygen.

B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following are toxicity data currently available for the Carbon component; the remaining components are inert.

CARBON DIOXIDE:

LCLo (Inhalation-Human) 9 pph/5 minutes

LCLo (Inhalation-Human) 11 pph

TCLo (Inhalation-Human) 0.25 pph: Lungs, Thorax, or Respiration: dyspnea; Vascular: other changes

TCLo (Inhalation-Human) 2.5 pph: Cardiac: pulse rate; Behavioral: headache; Vascular: BP elevation not characterized in autonomic section

TCLo (Inhalation-Human) 7 pph: Behavioral: irritability; Brain and Coverings: other degenerative changes; Nutritional and Gross Metabolic: body temperature decrease

TCLo (Inhalation-Rat) 21 pph/1 hour: Cardiac: other changes, pulse rate, arrhythmias (including changes in conduction)

TCLo (Inhalation-Rat) 10,000 ppm/24 hours/30 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-Mouse) 20 pph: Lungs, Thorax, or Respiration: acute pulmonary edema

CARBON DIOXIDE (continued):

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

TCLo (Inhalation-Rabbit) 5 pph/5 hours: Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol), changes in cell count (unspecified); Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: multiple enzyme effects

TCLo (Inhalation-Rabbit) 3 pph/7 days: Blood: normocytic anemia

TCLo (Inhalation-Rabbit) 0.1 pph/20 minutes: Blood: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: carbonic anhydrase

CARBON DIOXIDE (continued):

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

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

TCLo (Inhalation-Dog) 5 pph: Cardiac: changes in coronary arteries, pulse rate; Vascular: BP elevation not characterized in autonomic section

TCLo (Inhalation-Dog) 10 pph: Lungs, Thorax, or Respiration: dyspnea; Autonomic Nervous System: other (direct) parasympathomimetic

TCLo (Inhalation-Dog) 4 pph/1 hour/7 days-intermittent: Lungs, Thorax, or Respiration: respiratory stimulation; Blood: changes in erythrocyte (RBC) count

TCLo (Inhalation-Mammal-Species Unspecified) 11 pph/2 hours: Blood: normocytic anemia

TCLo (Inhalation-Mammal-Species Unspecified) 70 pph: Cardiac: arrhythmias (including changes in conduction); Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol); Nutritional and Gross Metabolic: changes in potassium

LCLo (Inhalation-Mammal-Species Unspecified) 90,000 ppm/5 minutes

IRRITANCY OF PRODUCT: This gas mixture may be moderately to severely irritating to contaminated tissue, depending on the duration and concentration of exposure.

SENSITIZATION OF PRODUCT: The components of this gas mixture are not known to be a human skin or respiratory sensitizers.

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

Mutagenicity: No human mutagenic effects have been described for the components of this gas mixture.

Embryotoxicity: No human embryotoxic effects have been described for the components of this gas mixture.

Teratogenicity: No human teratogenic effects have been described for the components of this gas mixture.

Reproductive Toxicity: No human reproductive effects have been described for the components of this gas mixture. Animal reproductive data are available for Carbon Dioxide (a component of this gas mixture); these data were obtained during clinical studies on specific animal tissues exposed to this compound.

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

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

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas mixture will be dissipated rapidly in well-ventilated areas. The following environmental data are available for some components, as follows:

CARBON DIOXIDE: Food chain concentration potential: None. Biological Oxygen Demand: None. Log P = 0.83

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C and 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: This gas mixture may cause harm to contaminated plants and animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: This gas mixture may have adverse effects on aquatic life. Currently, the following aquatic toxicity data are available for Carbon Dioxide, a component of this gas mixture:

Lethal (trout) 1 hour = 240 mg/L

Lethal (rainbow trout) 96 hours = 35 mg/L

Harmful to some species of aquatic life in concentrations less than 20 mg/L

Lethal (rainbow trout) 12 hours = 60-240 mg/L

MOBILITY: The components of this gas mixture should volatilize rapidly and so should not present a significant hazard of mobility.

SECTION 12. ECOLOGICAL INFORMATION (Continued)

PERSISTENCE AND BIODEGRADABILITY: Persistence: Helium, Nitrogen and Xenon are natural elements and present no hazard of persistence. Carbon Dioxide persists in the atmosphere. Biodegradation: Helium, Nitrogen and Xenon are fully biodegradable. Carbon Dioxide does not biodegrade, but will decompose in ultraviolet light to form carbon monoxide and oxygen.

POTENTIAL TO BIOACCUMULATE: The components of this gas mixture do not have bioaccumulation or food chain contamination potential.

OZONE-DEPLETION POTENTIAL: The components of this gas mixture are not Class I or Class II ozone depleting chemicals (40 CFR Part 82).

SECTION 13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER: Do not dispose of unused product. Return used product in cylinders to: Spectra Gases, Inc., 80 Industrial Drive, Alpha, NJ 08865 or Spectra Gases, Inc., 1261 Activity Drive, Vista, CA 92083.

DISPOSAL INFORMATION: Residual product may be safely released in a well-ventilated area. This shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EU member states.

SECTION 14. TRANSPORT INFORMATION

U.S. SHIPPING INFORMATION:

U.S. DOT PROPER SHIPPING NAME: Compressed gases, n.o.s. (carbon dioxide, helium) **or**, (carbon dioxide, nitrogen) **or**, (carbon dioxide, xenon)

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

UN IDENTIFICATION NUMBER: UN 1956

U.S. DOT SHIPPING LABEL(S) REQUIRED: Class 2.2 (Non-Flammable Gas)

PLACARD (When required): Class 2.2 (Non-Flammable Gas)

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position in a well-ventilated truck (never transport in passenger compartment of a vehicle). Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

CAUTION: Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).

NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #: 126

CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas mixture is classified as Dangerous Goods, per regulations of Transport Canada. The use of the above U.S. DOT information from the U.S. 49 CFR regulations is allowed for shipments that originate in the U.S. For shipments via ground vehicle or rail that originate in Canada, the following information is applicable.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (carbon dioxide, helium) **or**, (carbon dioxide, nitrogen) **or**, (carbon dioxide, xenon)

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

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Not Applicable

HAZARD SHIPPING LABEL(S) REQUIRED: Class 2.2 (Non-Flammable Gas)

SPECIAL PROVISIONS: None

EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX: 0.125

ERAP INDEX: None

PASSENGER CARRYING SHIP INDEX: None

PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX: 75

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):

IATA DESIGNATION: This gas is classified as dangerous goods, per the International Air Transport Association.

UN IDENTIFICATION NUMBER: UN 1956

PROPER SHIPPING NAME/DESCRIPTION: Compressed gases, n.o.s. (carbon dioxide, helium) **or**, (carbon dioxide, nitrogen) **or**, (carbon dioxide, xenon)

HAZARD CLASS or DIVISION: 2.2 (Non-Flammable Gas)

HAZARD LABEL(S) REQUIRED: Class 2.2 (Non-Flammable Gas)

PACKING GROUP: None

PASSENGER and CARGO AIRCRAFT PACKING INSTRUCTION: 200

PASSENGER and CARGO AIRCRAFT MAXIMUM NET QUANTITY PER PKG: 75 kg

PASSENGER and CARGO AIRCRAFT LIMITED QUANTITY PACKING INSTRUCTION: None

PASSENGER and CARGO AIRCRAFT LIMITED QUANTITY MAXIMUM NET QUANTITY PER PKG: None

CARGO AIRCRAFT ONLY PACKING INSTRUCTION: 200

CARGO AIRCRAFT ONLY MAXIMUM NET QUANTITY PER PKG: 150 kg

SPECIAL PROVISIONS: None

ERG CODE: 2L

SECTION 14. TRANSPORT INFORMATION (Continued)
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INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

IMO DESIGNATION: This gas is classified as dangerous goods, per the International Maritime Organization.

UN No.: 1956

PROPER SHIPPING NAME: Compressed gases, n.o.s. (carbon dioxide, helium) *or*,
(carbon dioxide, nitrogen) *or*, (carbon dioxide, xenon)

HAZARD CLASS NUMBER: 2.2

PACKING GROUP: None

SPECIAL PROVISIONS: None

LIMITED QUANTITIES: 120 mL

PACKING INSTRUCTIONS: P200

EmS: F-C, S-V

STOWAGE CATEGORY: Category A

MARINE POLLUTANT: The components of this gas mixture are not designated by the IMO to be a Marine Pollutant.

EUROPEAN SHIPPING INFORMATION:

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This gas is classified by the Economic Commission for Europe to be dangerous goods. Additional information is as follows:

UN NO.: 1956

NAME and DESCRIPTION: Compressed gases, n.o.s. (carbon dioxide, helium) *or*,
(carbon dioxide, nitrogen) *or*, (carbon dioxide, xenon)

CLASS: 2

CLASSIFICATION CODE: 2A

PACKING GROUP: Not Applicable

LABELS: 2.2

SPECIAL PROVISIONS: None

LIMITED QUANTITIES: LQ1

PACKING INSTRUCTIONS: P200

MIXED PACKING PROVISIONS: MP9

HAZARD IDENTIFICATION No.: 20

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:**EPA - ENVIRONMENTAL PROTECTION AGENCY:**

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1990
(40 CFR Parts 117 and 302)

Reportable Quantity (RQ): Not Applicable

SARA TITLE III: Superfund Amendment and Reauthorization Act

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

Extremely Hazardous Substances: Components are not listed.

Threshold Planning Quantity (TPQ): Not Applicable

Reportable Quantity (RQ): Not Applicable

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: Yes PRESSURE: Yes

DELAYED HEALTH: No REACTIVITY: No

FIRE: No

SECTION 313: Toxic Chemical Release Reporting (40 CFR 372)

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

CLEAN AIR ACT:

SECTION 112 (r): Risk Management Programs for Chemical Accidental Release

(40 CFR Part 68)

Threshold Planning Quantity (TPQ): Not Applicable

TSCA: Toxic Substances Control Act: On TSCA Inventory

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119: Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): Not Applicable

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: The components of this gas mixture are not listed substances which the State of California requires warning under this statute.

CANADIAN FEDERAL REGULATIONS:

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

SECTION 15. REGULATORY INFORMATION (Continued)**CANADIAN FEDERAL REGULATIONS (continued):**

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

EUROPEAN UNION REGULATIONS:

EU LABELING AND CLASSIFICATION: This gas mixture is classified as hazardous, as per EU Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC. The following is a self-classification.

EU CLASSIFICATION: Xi [Irritant]

EU RISK PHRASES: R: 36 [Irritating to eyes.]

EU SAFETY PHRASES: [S:(1/2)*]: Keep locked up and out of the reach of children.* **This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.* [S: 26]: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. [S: 36/37/39]: Wear suitable protective clothing, gloves and eye/face protection. [S: 45]: In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).

EUROPEAN UNION ANNEX II HAZARD SYMBOL: Xi [Irritant]

SECTION 16. OTHER INFORMATION

Information contained in this Material Safety Data Sheet is provided to our customers so they may comply with 29 CFR 1910.1200, Hazard Communication Standard, the Canadian WHMIS Standard, and the requirements of the European Union Directives. The intent of this Material Safety Data Sheet is to provide end users of this product with the health and physical hazards associated with possible exposure to this product. All statements, technical data and recommendations are based on readily available texts and data that Spectra Gases, Inc., believes to be reliable and accurate. Spectra Gases, Inc., makes no warranties, guarantees or representations of any kind with respect to this product or this data. It is the responsibility of the user to obtain and use the most recent version of this MSDS.

For Definition of Terms used in Spectra MSDSs see Spectra Gases, Inc. website: www.spectra-gases.com. Or contact your Customer Service Representative.

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