



# MATERIAL SAFETY DATA SHEET

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

## SECTION 1. PRODUCT IDENTIFICATION

**PRODUCT NAME:** Equal to or Greater than 1% to Less than 3.7% FLUORINE IN KRYPTON, XENON, ARGON, HELIUM, NEON and/or NITROGEN

**CHEMICAL NAME:** Mixture of Fluorine ( $\geq 1 - < 3.7\%$ ) 0-20% Krypton and/or Xenon; 0-99% Argon, Helium, Neon and/or Nitrogen

**FORMULA:** Fluorine = F<sub>2</sub>; Argon = Ar; Helium = He; Krypton Kr; Neon = Ne; Xenon = Xe; Nitrogen = N<sub>2</sub>

**SYNONYMS:** Not Applicable

**MANUFACTURER:** SPECTRA GASES, INC.

**ADDRESS:** 3434 Route 22 West  
Branchburg, NJ 08876, U.S.A.

**PHONE:** 908/252-9300

**FAX:** 908/252-0811

**WEB SITE:** www.spectra-gases.com

**SPECTRA GASES EMERGENCY CONTACT:** (800) 932-0624 8:30 am - 7:00 pm (EST)

**24 HOUR EMERGENCY CONTACT, CHEMTREC:** 800/424-9300, 202/484-7616

**DATE OF LAST REVISION:** June 12, 2006

**MSDS NUMBER:** 1203

**PRODUCT USE:** In Excimer Lasers

## SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

**COMPOSITION:** Fluorine  $\geq 1\% - < 3.7\%$  and Krypton 0-20%; Xenon 0-20%; Argon 0-99%; Helium 0-99%; Neon 0-99%; and/or Nitrogen 0-99%

**CAS NUMBER:** Fluorine 7782-41-4; Argon 7440-37-1; Helium 7440-59-7; Krypton 7439-90-9; Neon 7440-01-9; Xenon 7440-63-3; Nitrogen 7727-37-9

**EINECS NUMBER:** Fluorine 231-954-8; Argon 231-147-0; Helium 231-168-5; Krypton 231-098-5; Neon 231-110-9; Xenon 231-172-7; Nitrogen 231-783-9

**EXPOSURE LIMITS:** (10,000 ppm = 1%)

	OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
Fluorine:	TWA = 0.1 ppm	TWA = 1 ppm STEL = 2 ppm	TWA = 0.1 ppm IDLH = 25 ppm
Argon:	There are no exposure limits for Argon, Argon is a simple asphyxiant.		
Helium:	There are no exposure limits for Helium, Helium is a simple asphyxiant.		
Krypton:	There are no exposure limits for Krypton, Krypton is a simple asphyxiant.		
Neon:	There are no exposure limits for Neon, Neon is a simple asphyxiant.		
Xenon:	There are no exposure limits for Xenon, Xenon is a simple asphyxiant.		
Nitrogen:	There are no exposure limits for Nitrogen, Nitrogen is a simple asphyxiant.		

## SECTION 3. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** This gas is a colorless, non-flammable, gas mixture with a pungent odor (due to the presence of Fluorine), shipped under pressure. This gas mixture may cause significant, adverse health effects, because of the Fluorine content, which can reach exposure limits at the percentage in this mixture. Pure Fluorine is a powerful caustic irritant to all tissues, subsequently releases of this gas mixture should be responded to with extreme caution. Fluorine has a pungent odor and a low odor threshold; the odor of this product provides a good warning of a release of this gas mixture. Persons responding to releases of this gas mixture must protect themselves appropriately.

### SECTION 3. HAZARD IDENTIFICATION (Continued)

**ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING** - If rescue personnel need to enter an area suspected of having a toxic level of Fluorine (a component of this gas mixture), 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:** Minor contact with this gas will cause tearing and irritation including swelling and redness as Fluorine is a lachrymator. Severe over-exposure to the eyes has the potential to cause burns if contact is prolonged. Release of a high-pressure gas may result in airborne objects.

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

**INHALATION:** This gas mixture can cause significant, adverse effects, due to the presence of Fluorine, which is extremely toxic. Minor inhalation exposure of this gas mixture may cause irritation to the lungs, nose, throat and mucous membranes, resulting in coughing and breathing difficulty. In the event of prolonged inhalation overexposures, there is the potential for tissue damage. Severe inhalation overexposure may result in pulmonary edema (an accumulation of fluid in the lungs), a potentially fatal condition.

**SKIN CONTACT:** Contact of this gas mixture with the skin can cause mild to severe irritation, depending on the duration of exposure, due to the presence of Fluorine.

**OTHER HEALTH EFFECTS:** It is important to note that Fluorine may react with water or moist air to generate hydrofluoric acid solution or hydrogen fluoride gas. If 20% or more of the body is contaminated with hydrofluoric acid, hypocalcemia (a life-threatening lowering of serum calcium in the body) may result. Though *not expected* to occur from overexposures to this product, individuals should use this product with extreme care. Contact with rapidly expanding gases (which are released from 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.

**HMIS RATINGS:** HEALTH HAZARD: = 2; FLAMMABILITY HAZARD: = 0; PHYSICAL HAZARD: = 1;

**ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:**

**ROUTE OF ENTRY:** Inhalation

**TARGET ORGANS:** Respiratory System

**SYMPTOMS:** Persistent irritation may result from repeated exposure to this gas mixture. Repeated overexposure to a corrosive gas mixture can result in emphysema. However, at the concentration level of fluorine in this mix, the gas is not classified as corrosive. Repeated over-exposure to low levels of fluorine for extended periods of time (i.e. years or decades) may lead to a condition called fluorosis, which is a weakening and degeneration of bone structure.

**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:** Pre-existing dermatitis, other skin conditions, and respiratory disorders may be aggravated by over-exposure to this gas mixture. Additionally, repeated over-exposure to low levels of fluorine for extended periods of time (i.e. years or decades) may aggravate dental problems, heart conditions, bone disorders, and eye problems.

**CARCINOGENICITY:** The components of this gas mixture are not found on the FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or IARC Carcinogenicity lists and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies.

### SECTION 4. FIRST AID MEASURES

**EYE CONTACT:** If this gas mixture contaminates the eyes, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Administer anesthetic eye drops after one minute of flushing if victim suffers from spasms to the eyes, in order to facilitate irrigation. In the event of a severe overexposure, victim should consult with an ophthalmologist. 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 gas.

**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 develops after exposure, victim must seek appropriate medical attention.

**SKIN CONTACT:** If this gas mixture contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. If necessary, calcium gluconate gel can be applied to affected areas. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim should seek appropriate medical attention if symptoms persist. 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.

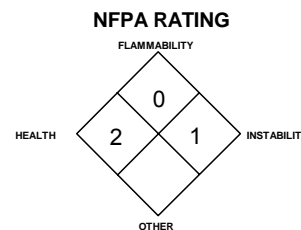
**SECTION 5. FIRE FIGHTING MEASURES****FLASH POINT:** Not Applicable**AUTOIGNITION:** Not Applicable**FLAMMABLE RANGE:** Not Applicable**NFPA RATINGS:**

HEALTH: = 2

FLAMMABILITY: = 0

INSTABILITY: = 1

SPECIAL: None



**See Section 16 for  
Definition of Ratings**

**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:** Due to the presence of Fluorine, this gas mixture presents an inhalation hazard to firefighters. Pure Fluorine can react with a wide range of organic and inorganic materials. Due to the low concentration level of Fluorine in this mixture, conversion to sufficient Hydrofluoric Acid to warrant concern about acidity of fire-water and disposal issues is unlikely. Water should be used in a fire emergency to keep cylinders cool, if they cannot be removed from the fire area. Cylinders containing Fluorine as a component may not have a pressure relief device. Exposure to high heat, as in a fire situation, can cause the cylinder to rupture.**EXPLOSION SENSITIVITY TO MECHANICAL IMPACT:** Not sensitive.**EXPLOSION SENSITIVITY TO STATIC DISCHARGE:** Not sensitive.**HAZARDOUS COMBUSTION PRODUCTS:** The inert gases in this mixture will not decompose in fire to produce toxic compounds. The Fluorine component of this gas mixture will produce toxic combustion products including hydrogen fluoride and oxygen difluoride.**SECTION 6. ACCIDENTAL RELEASE MEASURES****STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:** In the event of a leak of this product, operator should close the gas source if possible to do so safely. Evacuate immediate area. Only trained personnel, wearing Self-Contained Breathing Apparatus (SCBA) and a chemically resistant suit should re-enter a contaminated area. Persons responding to a release of a pressurized gas should be aware of the severe hazard of mechanical injury in the event of valve failure or other event causing a rapid release of cylinder contents.

If leak is in user's gas handling equipment or system, close cylinder valve, safely vent high pressure and purge with inert gas, being sure to bring purge gas to near atmospheric pressure before attempting repairs. If leak is from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

Levels of Fluorine should be below applicable exposure levels listed in Section 2 (Composition / Information on Ingredients) before personnel can be allowed in the area without SCBA. Detection systems may be considered to monitor for leaks and to measure the level of Fluorine.

**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:** This mixture can be dangerous and should only be handled by trained personnel. Wearing contact lenses is not recommended when handling this gas mixture. Spectra Gases, Inc., strongly recommends that this gas mixture only be handled in areas with extensive venting capabilities, preferably a gas handling cabinet. Monitoring may be considered for areas in which this gas mixture is used. Detection of Fluorine odor should trigger immediate response and corrective action. Contaminated clothing should be removed and laundered separately before reuse.**Before using this gas, meticulous leak checking using inert gas is strongly recommended, particularly after new connections are made.** 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.

**SECTION 7. HANDLING AND STORAGE (Continued)**

**HANDLING (continued):** 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. The failure of a valve can result in violent release of the pressurized gas, creating a severe mechanical injury hazard.

**PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT:** Follow practices indicated in Section 6 (Accidental Release Measures). Purge gas handling equipment with inert gas and relieve pressure before attempting repairs. Systems that have been in fluorine service may become contaminated with a powder residue containing metal fluorides and small amounts of hydrogen fluoride. Use a respirator with dust filters and gloves.

**SPECIAL PRECAUTIONS:** 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. Spectra Gases, Inc. recommends that cylinders in use be secured within a ventilated enclosure such as a gas cabinet. Employee exposure should be monitored and reduced to the lowest practical levels using ventilation or other appropriate engineering controls. (Spectra Gases is not aware of any workplace situation with good gas delivery system design where exposure to any amount of this gas mixture is necessary under normal operating conditions. Ventilation is important for mitigating gas concentrations released in leak situations.)

*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) or equivalent standard of Canada, or standards of EC member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection). Please reference applicable regulations and standards for relevant details.*

**RESPIRATORY PROTECTION:** Maintain exposure levels of Fluorine below the levels listed in Section 2 (Composition / Information on Ingredients). Use supplied air respiratory protection if Fluorine levels exceed exposure limits, 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 Canada, the European Standard EN149, and EC member states. The following guidelines, based on NIOSH respiratory protection recommendations, are for Fluorine.

**CONCENTRATION**  
**of FLUORINE**

**RESPIRATORY EQUIPMENT**

Up to 1 ppm	Supplied Air Respirator (SAR)
Up to 2.5 ppm	Supplied Air Respirator operated in continuous-flow mode.
Up to 5 ppm	Full-facepiece SCBA, or full-facepiece Supplied Air Respirator.
Up to 25 ppm	Positive-pressure, full-facepiece Supplied Air Respirator.
Emergency or Planned Entry into Unknown Concentration or IDLH Conditions:	Positive-pressure, full facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
Escape	Gas mask or mouth-piece respirator with acid gas cartridges or escape-type SCBA should be used.

**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 OSHA 29 CFR 1910.133 or by the European Standard EN166. Eye wash stations/safety showers should be available.

**SKIN PROTECTION:** Work (such as leather) gloves are recommended when handling cylinders of this gas. Use appropriate gloves for spill response. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada and those of EC Member States.

**OTHER PROTECTIVE EQUIPMENT:** Use body protection appropriate for task. Safety shoes are recommended when handling cylinders. Information on general protective measures can be found in U.S. OSHA 29 CFR 1910.136.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

The following information is for Argon, which may be a component of this mixture:

**MOLECULAR WEIGHT:** 39.95  
**GAS DENSITY @ 21.1°C (70°F):** 0.103 lb/ft<sup>3</sup> (1.650 kg/m<sup>3</sup>)  
**BOILING POINT @ 1 atm:** -185.9°C (-302.6°F)  
**FREEZING/MELTING POINT @ 1 atm:** -189.2°C (-308.6°F)  
**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 1.38  
**SOLUBILITY IN WATER vol/vol at 0°C (32°F) and 1 atm:** 0.056  
**SPECIFIC VOLUME @ 21.1°C (70°F):** 9.71 ft<sup>3</sup>/lb (0.606 m<sup>3</sup>/kg)  
**CRITICAL PRESSURE:** 711.5 psia (4905 kPa abs)  
**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.  
**ODOR THRESHOLD:** Argon is odorless.

The following information is for Helium, which may be a component of this mixture:

**MOLECULAR WEIGHT:** 4.00  
**GAS DENSITY @ 21.1°C (70°F):** 0.0103 lb/ft<sup>3</sup> (0.165 kg/m<sup>3</sup>)  
**BOILING POINT @ 1 atm:** -268.9°C (-452.1°F)  
**FREEZING/MELTING POINT @ 1 atm:** None.  
**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 1.38  
**SOLUBILITY IN WATER vol/vol at 0°C (32°F) and 1 atm:** 0.0094  
**SPECIFIC VOLUME @ 21.1°C (70°F):** 97.09 ft<sup>3</sup>/lb (6.061 m<sup>3</sup>/kg)  
**CRITICAL PRESSURE:** 33.0 psia (227 kPa abs)  
**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.  
**ODOR THRESHOLD:** Helium is odorless.

The following information is for Krypton, which may be a component of this mixture:

**MOLECULAR WEIGHT:** 83.80  
**GAS DENSITY @ 21.1°C (70°F):** 0.2172 lb/ft<sup>3</sup> (3.479 kg/m<sup>3</sup>)  
**BOILING POINT @ 1 atm:** -153.4°C (-244.0°F)  
**FREEZING/MELTING POINT @ 1 atm:** -157°C (-251°F)  
**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 2.899  
**SOLUBILITY IN WATER vol/vol at 20°C (68°F) and 1 atm:** 0.0594  
**SPECIFIC VOLUME @ 21.1°C (70°F):** 4.604 ft<sup>3</sup>/lb (0.287 m<sup>3</sup>/kg)  
**CRITICAL PRESSURE:** 798.0 psia (5502 kPa abs)  
**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.  
**ODOR THRESHOLD:** Krypton is odorless.

The following information is for Neon, which may be a component of this mixture:

**MOLECULAR WEIGHT:** 20.183  
**GAS DENSITY @ 21.1°C (70°F):** 0.05215 lb/ft<sup>3</sup> (1.83536 kg/m<sup>3</sup>)  
**BOILING POINT @ 1 atm:** -246.0°C (-410.9°F)  
**FREEZING/MELTING POINT @ 1 atm:** -248.7°C (-415.6°F)  
**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 0.696  
**SOLUBILITY IN WATER vol/vol at 0°C (32°F) and 1 atm:** 0.0105  
**SPECIFIC VOLUME @ 21.1°C (70°F):** 19.18 ft<sup>3</sup>/lb (1.197 m<sup>3</sup>/kg)  
**CRITICAL PRESSURE:** 384.9 psia (2654 kPa abs)  
**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.  
**ODOR THRESHOLD:** Neon is odorless.

The following information is for Xenon, which may be a component of this mixture:

**MOLECULAR WEIGHT:** 131.3  
**GAS DENSITY @ 21.1°C (70°F):** 0.3416 lb/ft<sup>3</sup> (5.472 kg/m<sup>3</sup>)  
**BOILING POINT @ 1 atm:** -108.2°C (-162.6°F)  
**FREEZING/MELTING POINT @ 1 atm:** -168°F (-111°C)  
**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 4.560  
**SOLUBILITY IN WATER vol/vol at 20°C (68°F) and 1 atm:** 0.108  
**SPECIFIC VOLUME @ 21.1°C (70°F):** 2.927 ft<sup>3</sup>/lb (0.183 m<sup>3</sup>/kg)  
**CRITICAL PRESSURE:** 847.0 psia (5840 kPa abs)  
**COEFFICIENT WATER/OIL DISTRIBUTION:** Not applicable.  
**ODOR THRESHOLD:** Xenon is odorless.

**SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES (Continued)**

The following information is for **Nitrogen**, which may be a component of this mixture:

**MOLECULAR WEIGHT:** 28.01

**GAS DENSITY @ 21.1°C (70°F):** 0.072 lb./ft<sup>3</sup> (1.153 kg/m<sup>3</sup>)

**BOILING POINT @ 1 atm:** -195.8°C (-320.4°F)

**FREEZING/MELTING POINT @ 1 atm:** -210°C (-345.8°F)

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

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

**SPECIFIC VOLUME @ 21.1°C (70°F):** 13.8 lb/ft<sup>3</sup> (0.867 m<sup>3</sup>/kg)

**CRITICAL PRESSURE:** 492.9 psia (3399 kPa abs)

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

**ODOR THRESHOLD:** Nitrogen is odorless.

**APPEARANCE, ODOR AND STATE:** Colorless, odorless gas.

**WARNING PROPERTIES FOR THIS GAS:** There are no warning properties in the event of a release.

The following information is for the **Fluorine** component of this gas mixture.

**MOLECULAR WEIGHT:** 38.00

**GAS DENSITY @ 21.1°C (70°F):** 0.098 lb/ft<sup>3</sup> (1.57 kg/m<sup>3</sup>)

**BOILING POINT @ 1 atm:** -188.2°C (-306.8°F)

**MELTING POINT @ 1 atm:** -219.7°C (-363.4°F)

**SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F):** 1.312

**SPECIFIC VOLUME @ 21.1°C (70°F):** 10.17 ft<sup>3</sup>/lb (0.635 m<sup>3</sup>/kg)

**CRITICAL PRESSURE:** 756.4 psia (5215 kPa abs)

**ODOR THRESHOLD:** 0.097-0.19 ppm (unspecified)

**VAPOR PRESSURE @ 20°C (68°F):** > 760 mm Hg

Information for **gas mixture:**

**APPEARANCE, ODOR AND STATE:** Colorless gas with pungent odor.

**WARNING PROPERTIES FOR THIS GAS MIXTURE:** The odor and its lacrymation properties can be distinctive warning properties associated with this gas mixture.

**SECTION 10. STABILITY AND REACTIVITY**

**CHEMICAL STABILITY:** Argon, Helium, Krypton, Neon, Xenon and Nitrogen are inert and stable. Fluorine reacts with water or moisture in the air to form hydrogen fluoride or hydrofluoric acid, plus small amounts of ozone, hydrogen peroxide and oxygen fluoride.

**CONDITIONS TO AVOID:** Cylinders should not be exposed to temperatures in excess of 125°F (52°C).

**MATERIALS WITH WHICH GAS MIXTURE IS INCOMPATIBLE:** Although the components of greatest percentage are inert, the Fluorine present in this mixture will react with nearly all organic and inorganic materials. Reactions of Fluorine with bases may be violent. While pure Fluorine very strongly enhances the oxidization (burning and/or corrosion) of all metals, the dilute concentration of Fluorine in this gas mixture lessens the incompatibility hazards. Properly prepared systems of stainless steel (316 type), copper, nickel or Monel can be appropriate for this mixture. All equipment should be free of grease or oils ("cleaned for oxygen service"). Do not use brass gas handling equipment. This product must be handled with care by appropriately trained and experienced personnel.

**REACTIVITY:**

**A) HAZARDOUS DECOMPOSITION PRODUCTS:** Fluorine reacts with water or moisture in the air to form a mixture containing hydrogen fluoride or hydrofluoric acid, plus small amounts of ozone, hydrogen peroxide and oxygen fluoride.

**B) HAZARDOUS POLYMERIZATION:** Will not occur.

**SECTION 11. TOXICOLOGICAL INFORMATION**

**TOXICITY DATA:** There are no specific toxicology data for Argon, Helium, Krypton, Neon, Xenon or Nitrogen. These gases are simple asphyxiants, which cause suffocation by replacing air (oxygen). Suffocation without warning is not likely with this mixture because the fluorine component provides an odor warning. The following toxicological data are available for Fluorine.

**SECTION 11. TOXICOLOGICAL INFORMATION (cont'd)**

Standard Draize Test (Eye-Human) 25 ppm/5 minutes: Mild	LC <sub>50</sub> (Inhalation-Mouse) 150 ppm/1 hour: Sense Organs and Special Senses (Eye):	LC <sub>50</sub> (Inhalation-Rabbit) 270 ppm/30 minutes: Sense Organs and Special Senses (Eye):
Standard Draize Test (Eye-Rat) 140 ppm/30 minutes	iritis; Lungs, Thorax, or Respiration: dyspnea; Nutritional and Gross Metabolic: weight loss or decreased weight gain	iritis; Lungs, Thorax, or Respiration: dyspnea; Nutritional and Gross Metabolic: weight loss or decreased weight gain
Standard Draize Test (Eye-Mouse) 467 ppm/5 minutes	LC <sub>50</sub> (Inhalation-Dog) 1120 mg/m <sup>3</sup> /15 minutes: Brain and Coverings: recordings from specific areas of CNS; Lungs, Thorax, or Respiration: fibrosis, focal (pneumoconiosis), acute pulmonary edema	LC <sub>50</sub> (Inhalation-Guinea Pig) 170 ppm/1 hour: Sense Organs and Special Senses (Eye):
Standard Draize Test (Eye-Dog) 68 ppm/1 hour		iritis; Lungs, Thorax, or Respiration: dyspnea; Nutritional and Gross Metabolic: weight loss or decreased weight gain
LC <sub>50</sub> (Inhalation-Rat) 185 ppm/1 hour: Sense Organs and Special Senses (Eye): conjunctive irritation; Lungs, Thorax, or Respiration: dyspnea; Nutritional and Gross Metabolic: weight loss or decreased weight gain		TCLo (Inhalation-Rat) 10 mg/m <sup>3</sup> /2 hours/10 days-intermittent: Liver: liver function tests impaired; Musculoskeletal: other changes; Nutritional and Gross Metabolic: weight loss or decreased weight gain

**CARCINOGENICITY:** The components of this gas mixture have not been found to be carcinogenic.

**IRRITANCY OF PRODUCT:** This gas mixture may be mildly to severely irritating to contaminated tissue, depending on the duration of contact.

**SENSITIZATION OF PRODUCT:** The components of this gas mixture are not known to be 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:** This gas mixture is not expected to cause mutagenic effects in humans. Fluorine, a component of this gas mixture, has been reported to cause mutagenic effects in specific animal tissues during experimental studies with exposures at relatively high doses.

**Embryotoxicity:** This gas mixture is not expected to cause embryotoxic effects in humans.

**Teratogenicity:** This gas mixture is not expected to cause teratogenic effects in humans.

**Reproductive Toxicity:** This gas mixture is not expected to cause adverse reproductive effects in humans.

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):** Biological Exposure Indices (BEIs) are applicable for Fluorine (a component of this gas mixture), as follows.

CHEMICAL DETERMINANT	SAMPLING TIME	BEI
FLUORIDES • Fluorides in urine	• Prior to shift • End of shift	• 3 mg/g creatinine • 10 mg/g creatinine

**SECTION 12. ECOLOGICAL INFORMATION**

**ENVIRONMENTAL STABILITY:** Argon, Helium, Krypton, Neon, Xenon and Nitrogen occur naturally in the atmosphere. In natural waters containing calcium and other alkali and alkaline earth metals, fluorine will precipitate out as calcium fluoride and other fluoride salts, and thus will naturally neutralize. Additionally, Fluorine reacts with water or moisture in the air to form a hydrogen fluoride or hydrofluoric acid. All work practices should be aimed at eliminating environmental contamination.

**EFFECT OF MATERIAL ON PLANTS or ANIMALS:** Due to the potentially toxic nature of this gas mixture, animals exposed to this product will experience tissue damage, burns, and may be killed. Plants contaminated with this product may be adversely affected or destroyed. The following phytotoxicity data are available for the components of this gas mixture:

**FLUORINE:** EC<sub>50</sub> (*Lemna minor* duckweed) 4 weeks = > 60,000 µg/L

**EFFECT OF CHEMICAL ON AQUATIC LIFE:** Fluorine, a component of this gas mixture, can be detrimental to aquatic life. If a large release of this product occurs near a river or other body of water, there is a potential for fish and other aquatic life to be harmed or killed. The following aquatic toxicity data are currently available for Fluorine, a component of this gas mixture:

**FLUORINE:** TLm (trout) time period not specified = 2.3 ppm (fresh water)

**MOBILITY:** Argon, Helium, Krypton, Neon, Xenon and Nitrogen are inert and do not present a hazard of mobility. Due to the reaction of Fluorine to hydrofluoric acid, it will not be mobile in soil.

**SECTION 12. ECOLOGICAL INFORMATION (cont'd)**

**Equal to or Greater than 1% to less than 3.7% Fluorine in Krypton, Xenon, Argon, Helium, Neon and/or Nitrogen PERSISTENCE AND BIODEGRADABILITY:** Persistence: Argon, Helium, Krypton, Neon, Xenon and Nitrogen are natural elements and present no hazard of persistence. Fluorine will react to form hydrofluoric acid which will be dissipated by natural alkalinity. Biodegradation: All components of this gas mixture will biodegrade

**POTENTIAL TO BIOACCUMULATE:** No data are currently available on the components of this gas mixture for bioaccumulation.

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

### SECTION 13. DISPOSAL CONSIDERATIONS

**UNUSED PRODUCT / EMPTY CONTAINER:** Do not dispose of residual 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 in system can be neutralized using various caustic systems (e.g., activated alumina or soda lime). Neutralization should only be done by appropriately trained and experienced personnel. Disposal shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EC member states.

### SECTION 14. TRANSPORT INFORMATION

#### U.S. SHIPPING INFORMATION:

**U.S. DOT PROPER SHIPPING NAME:** Compressed gas, n.o.s. (fluorine, argon) **or** (fluorine, helium) **or** (fluorine, neon) **or** (fluorine, krypton) **or** (fluorine, xenon) **or** (fluorine, nitrogen)

**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 is considered 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 gas, n.o.s. (fluorine, argon) **or** (fluorine, helium) **or** (fluorine, neon) **or** (fluorine, krypton) **or** (fluorine, xenon) **or** (fluorine, nitrogen)

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

**UN IDENTIFICATION NUMBER:** UN 1956

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

**SPECIAL PROVISIONS:** None

**EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX:** 0.12

**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 mixture is considered as dangerous goods, per the International Air Transport Association.

**PROPER SHIPPING NAME:** Compressed gas, n.o.s. (fluorine, argon) **or** (fluorine, helium) **or** (fluorine, neon) **or** (fluorine, krypton) **or** (fluorine, xenon) **or** (fluorine, nitrogen)

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

**UN IDENTIFICATION NUMBER:** UN 1956

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



**SECTION 14. TRANSPORT INFORMATION (Continued)**

The following Packaging Information is applicable to this product:

PASSENGER AND CARGO AIRCRAFT				CARGO AIRCRAFT ONLY	
Limited Quantity		Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg
Packing Instruction	Max. Qty per Pkg				
//////	//////	200	75 kg	200	150 kg

**INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):**

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

**UN No.:** 1956

**PROPER SHIPPING NAME:** Compressed gas, n.o.s. (fluorine, argon) *or* (fluorine, helium) *or* (fluorine, neon) *or* (fluorine, krypton) *or* (fluorine, xenon) *or* (fluorine, nitrogen)

**HAZARD CLASS NUMBER:** 2.2

**SUBSIDIARY RISK:** None

**PACKING GROUP:** None

**SPECIAL PROVISIONS:** 274

**LIMITED QUANTITIES:** 120 mL

**PACKING INSTRUCTIONS:** P200

**EmS:** F-C, S-U

**STOWAGE CATEGORY:** Category D. Clear of living quarters.

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

**EUROPEAN SHIPPING INFORMATION:**

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

**UN NO.:** 1956

**NAME and DESCRIPTON:** Compressed gas, n.o.s. (fluorine, argon) *or* (fluorine, helium) *or* (fluorine, neon) *or* (fluorine, krypton) *or* (fluorine, xenon) *or* (fluorine, nitrogen)

**CLASS:** 2

**CLASSIFICATION CODE:** IA

**PACKING GROUP:** Not Applicable

**LABELS:** 2.2

**SPECIAL PROVISIONS:** 274, 567

**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): Fluorine = 10 lb. (4.54 kg)

**SARA TITLE III:** Superfund Amendment and Reauthorization Act

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

Extremely Hazardous Substances: Argon, Helium, Krypton, Neon, Xenon and Nitrogen are not listed.

Fluorine is listed.

Threshold Planning Quantity (TPQ): Fluorine = 500 lb. (227.5 kg)

Reportable Quantity (RQ): Fluorine = 10 lb. (4.54 kg)

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

IMMEDIATE HEALTH: Yes

PRESSURE: Yes

DELAYED HEALTH: Yes

REACTIVITY: Yes

FIRE: No

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

Releases of Fluorine require reporting under Section 313.

**SECTION 15. REGULATORY INFORMATION (Continued)**

**CLEAN AIR ACT:**

**SECTION 112 (r):** Risk Management Programs for Chemical Accidental Release  
(40 CFR Part 68)

Threshold Planning Quantity (TPQ): Fluorine = 1000 lb. (454 kg)

**TSCA:** Toxic Substances Control Act

Neon, Helium, Nitrogen and Fluorine are listed on the TSCA Inventory.

**OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:**

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

Threshold Planning Quantity (TPQ): Fluorine = 1000 lb. (454 kg)

**U.S. STATE REGULATORY INFORMATION:**

**CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65):** No component of this gas mixture is a listed substance which the State of California requires warning under this statute.

The components of this gas mixture are covered under the following specific State regulations (more specific regulations exist in some States):

**Alaska - Designated Toxic and Hazardous Substances:** Argon; Fluorine, Helium, Neon, Nitrogen

**California - Permissible Exposure Limits for Chemical Contaminants:** Argon; Fluorine, Helium, Neon, Nitrogen

**Florida - Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**Illinois - Toxic Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**Kansas - Section 302/313 List:** Fluorine,

**Massachusetts - Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**Michigan - Critical Materials Register:** Argon, Helium, Nitrogen

**Minnesota - List of Hazardous Substances:** Argon; Fluorine, Helium, Neon, Nitrogen

**Missouri - Employer Information/Toxic Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**New Jersey - Right to Know Hazardous Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**North Dakota - List of Hazardous Chemicals, Reportable Quantities:** Fluorine.

**Pennsylvania - Hazardous Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**Rhode Island - Hazardous Substance List:** Argon; Fluorine, Helium, Neon, Nitrogen

**Texas - Hazardous Substance List:** Fluorine.

**West Virginia - Hazardous Substance List:** Fluorine.

**Wisconsin - Toxic and Hazardous Substances:** Fluorine.

**CANADIAN FEDERAL REGULATIONS:**

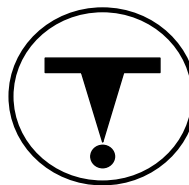
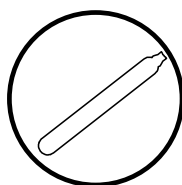
**CANADIAN DSL INVENTORY STATUS:** All components of this gas mixture are listed on the Canadian DSL Inventory.

**OTHER CANADIAN REGULATIONS:** This gas mixture would be categorized as a Controlled Product, Hazard Classes A, and D2, as per the Controlled Product Regulations. The inert gases are not on the CEPA Priorities Substances Lists. Fluorine (as an Inorganic Fluoride compound) would be on the First Priorities Substances List (Toxic).

**CANADIAN WHMIS CLASSIFICATION and SYMBOLS:**

**Class A:** Compressed Gas

**Class D2:** Toxic Material/Materials Causing Other Toxic Effects



**EUROPEAN ECONOMIC COMMUNITY REGULATIONS:**

**EC LABELING AND CLASSIFICATION:** This product meets the following definition, per the European Community Council Directive 67/548/EEC.

**EC CLASSIFICATION:** T (Toxic)

**EC RISK PHRASES:** Toxic by inhalation. Causes burns. [R: 23-34]

**EC SAFETY PHRASES:** 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.* Keep container tightly closed and in a well ventilated place. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing, gloves and eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). [S:(1/2)\*, 7/9, 26, 36/37/39, 45]

## SECTION 15. REGULATORY INFORMATION (Continued)

## EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOL:



## EUROPEAN COMMUNITY INFORMATION FOR COMPONENTS:

**ARGON:****EC EINECS/ELINCS NUMBER:** 231-147-0**EC CLASSIFICATION:** An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.**HELIUM:****EC EINECS/ELINCS NUMBER:** 231-168-5**EC CLASSIFICATION:** An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.**KRYPTON:****EC EINECS/ELINCS NUMBER:** 231-098-5**EC CLASSIFICATION:** An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.**NEON:****EC EINECS/ELINCS NUMBER:** 231-110-9**EC CLASSIFICATION:** An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.**XENON:****EC EINECS/ELINCS NUMBER:** 231-172-7**EC CLASSIFICATION:** An official classification for this substance has not been published in Commission Directives 93/72/EEC, 94/69 EC, or and 96/54/EC.**NITROGEN:****EC EINECS/ELINCS NUMBER:** 231-783-9**EC CLASSIFICATION:** Nitrogen does not meet the definition of any hazard class as defined by the ECC Directive 67/548/EEC.**FLUORINE:****EC EINECS/ELINCS NUMBER:** 231-954-8**EC CLASSIFICATION:** Very Toxic; Very Toxic by Inhalation; May Cause Fire; Causes Severe Burns: [R 7; T+; C]**EC RISK PHRASES:** May cause fire. Very toxic by inhalation. Causes severe burns. [R: 7, 26, 35]**EC SAFETY PHRASES:** 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.* Keep container tightly closed and in a well ventilated place. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing, gloves and eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). [S:(1/2)\*, 7/9, 26, 36/37/39, 45]**EC COMMENTS:** In terms of Fluorine toxicity, use the following concentration limits:

C ≥ 10%: Causes severe burns. [R: 35]

7% ≤ C &lt; 10%: Very Toxic. [R: 26-35]

5% ≤ C &lt; 7%: Toxic by inhalation. [R: 26-34]

1% ≤ C &lt; 5%: Toxic. [R: 23-34]

0.1% ≤ C &lt; 1%: Harmful. [R: 20]

**Product:** This gas mixture contains ≥ 1% - < 3.7% Fluorine and meets the requirements for classification and labeling for dangerous substances under European Community Standards.

## 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 Community 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.

Further information about compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

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

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

"Handbook of Compressed Gases"

**PREPARED BY:** CHEMICAL SAFETY ASSOCIATES, Inc.  
PO Box 3519, La Mesa, CA 91944-3519  
619/670-0609

REVISION HISTORY: 7/9/04: General up-date and review MSDS. Up-date of Section 14 shipping information.

8/2/04: Section 9 – corrected Helium Solubility in water to 0.0094

12/7/04: Sec. 1 updated phone #s, Sec. 9 added F2 info

4/20/05: Included information for nitrogen.

6/12/06: Sec. 3 clarified chronic symptoms/corrosive nature of gas

## DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

**CAS #:** This is the Chemical Abstract Service Number that uniquely identifies each constituent.

**EXPOSURE LIMITS IN AIR:**

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

**IDLH-Immediately Dangerous to Life and Health:** This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

**LOQ:** Limit of Quantitation.

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

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

**NIC:** Notice of Intended Change.

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

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

**EXPOSURE LIMITS IN AIR (continued):****DFG MAK Pregnancy Risk Group Classification (continued):**

**Group B:** Currently available information indicates a risk of damage to the developing embryo or fetus must be considered to be probable. Damage to the developing organism cannot be excluded when pregnant women are exposed, even when MAK and BAT values are observed. **Group C:** There is no reason to fear a risk of damage to the developing embryo or fetus when MAK and BAT values are observed.

**Group D:** Classification in one of the groups A-C is not yet possible because, although the data available may indicate a trend, they are not sufficient for final evaluation.

**NIOSH RELs:** NIOSH's Recommended Exposure Limits.

**PEL-Permissible Exposure Limit:** OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order.

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

## DEFINITIONS OF TERMS (Continued)

**EXPOSURE LIMITS IN AIR (continued):**

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

**TLV-Threshold Limit Value:** An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

**EXPOSURE LIMITS IN AIR (continued):**

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

**HAZARDOUS MATERIALS IDENTIFICATION SYSTEM**

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

**HEALTH HAZARD:**

**0 (Minimal Hazard):** No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation:* Essentially non-irritating. PII or Draize = "0". *Eye Irritation:* Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD<sub>50</sub> Rat:* < 5000 mg/kg. *Dermal Toxicity LD<sub>50</sub>Rat or Rabbit:* < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC<sub>50</sub> Rat:* < 20 mg/L.; **1 (Slight Hazard):** Minor reversible Injury may occur; slightly or mildly irritating. *Skin Irritation:* Slightly or mildly irritating. *Eye Irritation:* Slightly or mildly irritating. *Oral Toxicity LD<sub>50</sub> Rat:* > 500-5000 mg/kg. *Dermal Toxicity LD<sub>50</sub>Rat or Rabbit:* > 1000-2000 mg/kg. *Inhalation Toxicity LC<sub>50</sub> 4-hrs Rat:* > 2-20 mg/L.; **2 (Moderate Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD<sub>50</sub> Rat:* > 50-500 mg/kg. *Dermal Toxicity LD<sub>50</sub>Rat or Rabbit:* > 200-1000 mg/kg. *Inhalation Toxicity LC<sub>50</sub> 4-hrs Rat:* > 0.5-2 mg/L.; **3 (Serious Hazard):** Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation:* Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation:* Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD<sub>50</sub> Rat:* > 1-50 mg/kg. *Dermal Toxicity LD<sub>50</sub>Rat or Rabbit:* > 20-200 mg/kg. *Inhalation Toxicity LC<sub>50</sub> 4-hrs Rat:* > 0.05-0.5 mg/L.; **4 (Severe Hazard):** Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation:* Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation:* Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD<sub>50</sub> Rat:* ≤ 1 mg/kg. *Dermal Toxicity LD<sub>50</sub>Rat or Rabbit:* ≤ 20 mg/kg. *Inhalation Toxicity LC<sub>50</sub> 4-hrs Rat:* ≤ 0.05 mg/L).

**FLAMMABILITY HAZARD:**

**0 (Minimal Hazard-Materials)** that will not burn in air when exposure to a temperature of 815.5°C [1500°F] for a period of 5 minutes.; **1 (Slight Hazard-Materials)** that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur, Including: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C [200°F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]; **2 (Moderate Hazard-Materials)** that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, Including: Liquids having a flash-point at or above 37.8°C [100°F]; Solid materials in the form of coarse dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.);

**HAZARDOUS MATERIALS IDENTIFICATION SYSTEM****HAZARD RATINGS (continued):****FLAMMABILITY HAZARD (continued):**

**3 (Serious Hazard- Liquids and solids)** that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8°C [73°F] and having a boiling point at or above 38°C [100°F] and below 37.8°C [100°F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustible solids, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]; **4 (Severe Hazard-Materials)** that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C [73°F] and a boiling point below 37.8°C [100°F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4°C [130°F] or below [e.g. pyrophoric].

**PHYSICAL HAZARD:**

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

## Equal to or Greater than 1% to less than 3.7% Fluorine in Krypton, Xenon, Argon, Helium, Neon and/or Nitrogen DEFINITIONS OF TERMS (Continued)

### HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

#### HAZARD RATINGS (continued):

##### PHYSICAL HAZARD (continued):

**3 (Water Reactivity):** Materials that may form explosive reactions with water. **Organic Peroxides:** Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. **Explosives:** Division 1.2 – Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. **Compressed Gases:** Pressure  $\geq$  514.7 psi absolute at 21.1°C (70°F) [500 psig]. **Pyrophorics:** No Rating. **Oxidizers:** Packing Group I **Solids:** any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. **Oxidizers:** **Liquids:** Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%)/cellulose mixture. **Unstable Reactives:** Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4 (Water Reactivity):** Materials that react explosively with water without requiring heat or confinement. **Organic Peroxides:** Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. **Explosives:** Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. **Compressed Gases:** No Rating. **Pyrophorics:** Add to the definition of Flammability "4". **Oxidizers:** No "4" rating. **Unstable Reactives:** Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.).

##### NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

**HEALTH HAZARD:** **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury).

**FLAMMABILITY HAZARD:** **0** Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.

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

##### FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). **Flash Point** - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. **Autoignition Temperature:** The minimum temperature required to initiate combustion in air with no other source of ignition. **LEL** - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. **UEL** - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

##### TOXICOLOGICAL INFORMATION:

**Human and Animal Toxicology:** Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD<sub>50</sub>** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC<sub>50</sub>** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m<sup>3</sup>** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

##### ECOLOGICAL INFORMATION:

**EC** is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. **TL<sub>m</sub>** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K<sub>ow</sub>** or **log K<sub>oc</sub>** and is used to assess a substance's behavior in the environment.

##### REGULATORY INFORMATION:

###### U.S. and CANADA:

This section explains the impact of various laws and regulations on the material. **ACGIH:** American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **EPA** is the U.S. Environmental Protection Agency. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. **OSHA** - U.S. Occupational Safety and Health Administration.

**EUROPEAN:** **EC** is the European Community (formerly known as the **EEC**, European Economic Community). **EINECS:** This is the European Inventory of Now-Existing Chemical Substances. The **ARD** is the European Agreement Concerning the International Carriage of Dangerous Goods by Road and the **RID** are the International Regulations Concerning the Carriage of Dangerous Goods by Rail.