



MATERIAL SAFETY DATA SHEET

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

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: Fluorine Excimer Laser Mix (1.0% or less Fluorine)
US DOT NAME: Compressed Gas, n.p.s. (Fluorine, *other gas*) UN 1956 (see Sec. 14)
CHEMICAL NAME: Mixture of Fluorine (1.0% or Less) and Argon, Krypton or Xenon balance Helium, Neon or Nitrogen
FORMULA: Argon = Ar, Fluorine = F₂; Helium = He; Krypton = Kr; Neon = Ne; Nitrogen = N₂;
SYNONYMS: Not Applicable
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PRODUCT USE: In Excimer Laser and Research and Development

ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR. The product is also classified per all applicable EU Directives through EC 1907: 2006

SECTION 2. HAZARD IDENTIFICATION

EU LABELING AND CLASSIFICATION: This gas mixture meets the definition of hazardous according to the criteria of the European Union Council Directive 67/548/EEC and based on current guidelines under EC 1907: 2006.

EU CLASSIFICATION: Xn (Harmful)

EU RISK PHRASES: R: 20; R: 21; R: 36/37/38

EU SAFETY PHRASES: S: (1/2)*; S: 7/9, S: 26, S: 36/37/39, S: 45

See Section 15 for full definition of Risk and Safety Phrases.

EMERGENCY OVERVIEW: Product Description: This gas is a colorless, non-flammable, gas mixture, shipped under pressure.
Health Hazards: This gas mixture may cause adverse health effects due to its Fluorine content, which can reach exposure limits at the percentage in this mixture. Pure Fluorine is a powerful caustic irritant to all tissues; while the dilute concentration (1% or less) of Fluorine in this mixture significantly reduces exposure risk, releases of this product should be responded to with 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. **Flammability Hazards:** This mixture is not flammable. **Reactivity Hazards:** Due to the presence of Fluorine, this gas mixture may react with water or moisture in the air to form hydrogen fluoride or hydrofluoric acid, plus small amounts of ozone, hydrogen peroxide and oxygen fluoride. **Emergency Response Considerations:** Persons responding to releases of this gas must use extreme caution and protect themselves appropriately. **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).

SECTION 3. COMPOSITION and INFORMATION ON INGREDIENTS

(10,000 ppm = 1%)

CHEMICAL NAME	CAS #	EINECS#	Mole%	European Hazard Classification Risk Phrases Safety Phrases
Fluorine	7782-41-1	231-954-8	1.0% or less	HAZARD CLASSIFICATION: T+ (Toxic); C (Corrosive) RISK PHRASES: R: 7; R: 26; R: 35 SAFETY PHRASES: S: 1/2; S: 9; S: 26, S: 36/37/39; S: 45
Argon	7440-37-1	231-147-0	0-20%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable SAFETY PHRASES: Not Applicable
Helium	7440-59-7	231-168-5	0-99.9%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable SAFETY PHRASES: Not Applicable
Neon	7440-01-9	231-110-9	0-99.9%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable SAFETY PHRASES: Not Applicable

See Section 15 for full definition of Risk and Safety Phrases.

SECTION 3. COMPOSITION and INFORMATION ON INGREDIENTS (Continued)

(10,000 ppm = 1%)

CHEMICAL NAME	CAS #	EINECS#	Mole%	Risk Phrases Safety Phrases	European Hazard Classification
Nitrogen	7727-37-9	231-783-9	0-99.9%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable SAFETY PHRASES: Not Applicable	
Krypton	7439-90-9	231-098-5	0-20%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable SAFETY PHRASES: Not Applicable	
Xenon	7440-63-3	231-172-7	0-20%	HAZARD CLASSIFICATION: Not Applicable RISK PHRASES: Not Applicable SAFETY PHRASES: Not Applicable	

See Section 15 for full definition of Risk and Safety Phrases.

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 20 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.

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 (delayed signs of lung irritation are uncommon but possible up to 24 hours later), victim must seek appropriate medical attention.

SKIN CONTACT: Exposure to this mix is highly unlikely to result in tissue damage due to HF. However, if this gas mixture contaminates the skin, immediately begin decontamination with running water. If calcium gluconate gel or benzalkonium chloride solution is available flushing should be limited to 5 minutes. Otherwise, minimum flushing is for 15 minutes. Calcium gluconate gel or benzalkonium chloride solution (Trade Name: Zephiran Chloride Solution) can be applied to affected areas. For use of Zephiran Chloride Solution, soak area of exposure or apply compress soaked in solution. 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.

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.

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

For Inhalation Exposure: Administer 100% oxygen at half-hour intervals for three to four hours for victims of minor inhalation exposure. For serious inhalation exposure, 100% oxygen administration should begin immediately, under positive pressure (< 4 cm) for half-hour periods for at least six hours until breathing is easy and the color of the skin and mucous membranes is normal.

For Skin Contact: For skin contamination, all areas of exposure should be flushed with copious quantities of water, followed by an iced aqueous or alcoholic solution of 0.13% benzalkonium chloride, iced 70% alcohol, or an ice-cold saturated solution of magnesium sulfate. If the area of burn cannot be drenched or immersed in solution, apply cold compresses containing the materials of the solution. After the iced solution treatment, application of a paste of powdered magnesium oxide and glycerin should be administered. The paste should be applied daily for several days.

For Eye Contact: Exposed eyes should be flushed for 20 minutes, and the following additional treatment be provided: Treat with a continuous drip of 1 percent calcium gluconate in normal, sterile saline. No oils or ointments should be used.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not Applicable

AUTOIGNITION: Not Applicable

FLAMMABLE RANGE: Not Applicable

NFPA RATINGS:

HEALTH: = 1

FLAMMABILITY: = 0

INSTABILITY: = 1

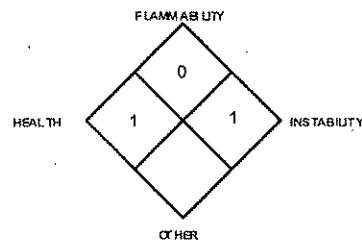
SPECIAL: None

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

EXTINGUISHING MEDIA NOT TO BE USED: None known.

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: Fluorine is an oxidizer (will support and accelerate combustion); however, this gas mixture is not considered oxidizing due to the low content of fluorine. Water should be used in a fire emergency to keep cylinders cool, if they cannot be removed from the fire area. Due to the low content of Fluorine in this mixture, conversion to sufficient Hydrofluoric Acid to warrant concern about acidity of fire-water and disposal issues is unlikely.

NFPA RATING

SECTION 5. FIRE FIGHTING MEASURES (Continued)

WARNING: 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

FIRST RESPONSE: In the event of a leak of this product, operator should close the gas source, if possible to do so safely. Evacuate immediate area. In the event of a significant release from a single cylinder, the North American Response Guidebook (ID #1050, Guide # 124) recommends 100 meters (330 feet) feet initial isolation from release for pure Fluorine.

TRAINED RESPONSE TEAM: Personal Protective Equipment should include appropriate body protection for Fluorine exposure, gloves, and Self-Contained Breathing Apparatus (SCBA). A water fog or mist can be used to control released gas. Do not direct a water spray directly at the source of release.

ENTRY TO AREA: Monitor the surrounding area for toxic gas level. Fluorine levels should be below the limits shown in Section 8 (Exposure Controls/Personal Protection), before personnel are allowed in the area without Self-Contained Breathing Apparatus.

REPAIR/FOLLOW-UP: If leak was in user's gas handling equipment or system, ensure cylinder is closed, system is purged and all high pressure is vented before attempting repairs. If leak was from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier. Do not flush contaminated water down the sewer systems. Flush into a retention area, and neutralize with appropriate material for Fluorine. Dilute with large amounts of water, then dispose of according to local regulations.

THIS IS A POTENTIALLY HARMFUL GAS MIXTURE. Protection of all personnel and the area must be maintained. All responders must be adequately protected from exposure.

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. Do not allow storage temperature to exceed 125°F (52°C). 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.
- 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.
- Cylinders must not be recharged except by or with the consent of owner.
- Consider installation of leak detection and alarm systems for storage areas.
- Isolate from incompatible chemicals (refer to Section 10, Stability and Reactivity).
- Use only DOT or ASME code cylinders designed for compressed gas storage.

HANDLING: This mixture can be dangerous and should only be handled by trained personnel. Before using this gas, meticulous leak checking using inert gas is strongly recommended, particularly after new connections are made. 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.

- 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.
- Inspect cylinder valves regularly for physical damage or corrosion (apparent by discoloration or rust). Valve inspection should include neck (where valve inserts into cylinder) and bonnet nut (where handle attaches to valve body).
- Use an adjustable strap-wrench to remove over-tight or rusted caps.
- Use a pressure regulator to safely discharge product from cylinder.
- Use a check valve to prevent reverse flow into cylinder.
- All equipment should be free of grease or oils.
- 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.
- Close valve after each use and when empty.
- Never tamper with pressure relief devices in valves and cylinders. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing leak to occur.
- Do not heat cylinders 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). 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.

SECTION 7. HANDLING AND STORAGE (Continued)

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.)

EXPOSURE LIMITS:

Chemical Name	CAS #	OSHA PELs ppm	ACGIH TLVs ppm	NIOSH RELs ppm	NIOSH IDLH ppm	DFG MAKs ppm	AIHA WEELs ppm
Fluorine	7782-41-4	TWA = 0.1	TWA = 1 STEL = 2	TWA = 0.1	25	NE	NE

Argon, Helium, Krypton, Nitrogen, Neon and Xenon are simple asphyxiants.

NE = Not Established

INTERNATIONAL OCCUPATIONAL EXPOSURE LIMITS: In addition to the exposure limit values cited in this section, other exposure limits have been established by various countries for Fluorine. The exposure limits given may not be the most current; individual country authorities should be contacted to check on more current limits.

ARAB Republic of Egypt: TWA = 0.1 ppm (0.2 mg/m³), JAN1993
 Australia: TWA = 1 ppm (2 mg/m³), STEL = 2 ppm, JAN1993
 Belgium: TWA = 1 ppm (1.6 mg/m³), STEL = 2 ppm, JAN1993
 Denmark: TWA = 0.1 ppm (0.2 mg/m³), OCT 2002
 EC: TWA = 1.58 mg/m³ (1 ppm); STEL = 3.16 mg/m³ (2 ppm), FEB 2006
 Finland: STEL = 0.1 ppm (0.26 mg/m³), JAN 1999
 France: VLE = 1 ppm (2 mg/m³), JAN 1999
 Hungary: TWA = 0.2 mg/m³, STEL = 0.4 mg/m³, JAN 1993
 Korea: TWA = 0.1 ppm (0.2 mg/m³), 2006
 Mexico: TWA = 2.5 mg(F)/m³, 2004
 New Zealand: TWA = 1 ppm (1.6 mg/m³); STEL = 2 ppm (3.1 mg/m³), JAN 2002

Norway: TWA = 0.1 ppm (0.2 mg/m³), JAN 1999
 The Philippines: TWA = 0.1 ppm (0.2 mg/m³), JAN 1993
 Poland: MAC(TWA) = 0.05 mg/m³, MAC(STEL) = 0.4 mg/m³, JAN 1999
 Russia: STEL = 0.03 mg/m³, JUN 2003
 Sweden: NGV = 0.1 ppm (0.2 mg/m³), KTV = 0.3 ppm (0.5 mg/m³), JAN 1999
 Switzerland: MAK-W = 0.1 ppm (0.15 mg/m³), KZG-W = 0.2 ppm (0.3 mg/m³), DEC 2006
 Thailand: TWA = 0.1 ppm (0.2 mg/m³), JAN 1993
 Turkey: TWA = 0.1 ppm (0.2 mg/m³), JAN 1993
 United Kingdom: TWA = 1 ppm; STEL = 1 ppm, 2005
 In Argentina, Bulgaria, Colombia, Jordan, Korea, 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 standards of Canada (including CSA Standard Z94.4-02 and CSA Standard Z94.3-02), or standards of EU member states (including EN 529:2005 for respiratory PPE, CEN/TR 15419:2006 for hand protection, and CR 13464:1999 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 above. 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 EN 529:2005, and EU member state standards. The following guidelines, based on NIOSH respiratory protection recommendations, are for Fluorine.

FLUORINE**CONCENTRATION**

Up to 1 ppm
 Up to 2.5 ppm
 Up to 5 ppm
 Up to 25 ppm
 Emergency or Planned Entry into Unknown Concentration or IDLH Conditions:

Escape

RESPIRATORY EQUIPMENT

Supplied Air Respirator (SAR)
 Supplied Air Respirator operated in continuous-flow mode.
 Full-facepiece SCBA, or full-facepiece Supplied Air Respirator.
 Positive-pressure, full-facepiece Supplied Air Respirator.

Positive-pressure, full facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
 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. If necessary, refer to U.S. OSHA 29 CFR 1910.133, Canadian CSA Standard Z94.3-07 or the European Standard CR 13464:1999. 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, appropriate Standards of Canada or the European Standard CEN/TR 15419:2006.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. Safety shoes are recommended when handling cylinders. If necessary, refer to the OSHA Technical Manual (Section VII: Personal Protective Equipment) appropriate Standards of Canada 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
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The following information is for inert components that may be part of this mixture:

	Argon	Helium	Krypton	Neon	Nitrogen	Xenon
Molecular Weight	39.95	4.00	83.80	20.183	28.01	131.3
Gas Density @ 21.1°C (70°F)	0.103 lb/ft ³ (1.650 kg/m ³)	0.0103 lb/ft ³ (0.165 kg/m ³)	0.2172 lb/ft ³ (3.479 kg/m ³)	0.05215 lb/ft ³ (1.83536 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	-185.9°C (-302.6°F)	-268.9°C (-452.1°F)	-153.4°C (-244.0°F)	-246.0°C (-410.9°F)	-246.0°C (-410.9°F)	-108.2°C (-162.6°F)
Freezing/Melting Point @ 1 atm	-189.2°C (-308.6°F)	None	-157°C (-251°F)	-248.7°C (-415.6°F)		-168°F (-111°C)
Specific Gravity (air = 1) @ 21.1°C (70°F)	1.38	0.138	2.899	0.696	-210°C (-345.8°F)	4.560
Solubility in Water vol/vol at 0°C (32°F) and 1 atm	0.056	0.0094	0.0594	0.0105	0.023	0.108
Specific Volume @ 21.1°C (70°F)	9.71 ft ³ /lb (0.606 m ³ /kg)	97.09 ft ³ /lb (6.061 m ³ /kg)	4.604 ft ³ /lb (0.287 m ³ /kg)	19.18 ft ³ /lb (1.197 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	711.5 psia (4905 kPa abs)	33.0 psia (227 kPa abs)	798.0 psia (5502 kPa abs)	384.9 psia (2654 kPa abs)	492.9 psia (3399 kPa abs)	847.0 psia (5840 kPa abs)
Odor Threshold	odorless	odorless	odorless	odorless	odorless	odorless

The following information is for the fluorine component of this mixture:

	Fluorine
Molecular Weight	38.00
Gas Density @ 21.1°C (70°F)	0.098 lb/ft ³ (1.57 kg/m ³)
Boiling Point @ 1 atm	-188.2°C (-306.8°F)
Freezing/Melting Point @ 1 atm	-219.7°C (-363.4°F)
Specific Gravity (air = 1) @ 21.1°C (70°F)	1.312
Solubility in Water vol/vol at 0°C (32°F) and 1 atm	
Specific Volume @ 21.1°C (70°F)	10.17 ft ³ /lb (0.635 m ³ /kg)
Critical Pressure	756.4 psia (5215 kPa abs)
Odor Threshold	0.02-0.19 ppm

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, Nitrogen and Krypton 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 concentration of Fluorine in this gas mixture lessens the incompatibility hazards. Properly prepared systems of copper, nickel, Hastalloy, or Monel can be appropriate for this mixture. Do not use brass gas handling equipment.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: *Combustion:* If involved in a fire, this gas mixture may evolve hydrogen fluoride and oxygen difluoride. *Hydrolysis:* 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

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. High concentration of this gas will create an oxygen-deficient atmosphere, creating the risk of asphyxiation. Acute overexposure to this gas mixture may cause the following health effects:

EYE CONTACT: Tearing and irritation including swelling and redness as Fluorine is a lachrymator. Severe over-exposure to the eyes has the potential to cause more intense irritation if contact is prolonged. Release of a high-pressure gas may result in airborne objects.

INGESTION: Not a likely route of industrial exposure.

INHALATION: 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 over-exposure may result in pulmonary edema (an accumulation of fluid in the lungs), a potentially fatal condition. Release of this gas mixture may create an oxygen-deficient atmosphere, which can cause asphyxiation; however the effects from Fluorine exposure will be more significant an immediate hazard.

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

OTHER HEALTH EFFECTS: Other health effects may be related to the hazards of compressed gases. Frostbite may result from contact with rapidly expanding gases that are released from under high pressure. Symptoms of frostbite include change in skin color to white or grayish-yellow.

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation

TARGET ORGANS: Respiratory System, Skeletal System

SYMPTOMS: Persistent irritation may result from repeated exposure to this gas mixture. Repeated over-exposure to a mixture that contains fluorine can result in emphysema. 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.

CARCINOGENIC POTENTIAL: The components of this gas mixture are not found on the U.S. EPA, U.S. NTP, U.S. OSHA, U.S. NIOSH, GERMAN MAK, IARC, or ACGIH Carcinogenicity lists and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies.

TOXICITY DATA: There are no specific toxicology data for Argon, Helium, Krypton, Neon, Nitrogen or Krypton. These gases are simple asphyxiants, which act to displace oxygen in the environment. The Fluorine component is in less than 1% concentration, so no toxicity data are presented in this MSDS.

Note: In the absence of toxicological information for a specific mixture, the following formula is published by these agencies/groups for classifying toxicity of a gas mixture with one toxic component:

US Dept. of Transportation (D.O.T.) (49 CFR 173.133(b)); Compressed Gas Association (CGA P-20)

International Air Transport Association (IATA 3.2.3);

National Fire Protection Association (NFPA 55 2003 ed.) ref CGA P-20

$$LC_{50}(\text{mix}) = \frac{LC_{50} \text{ of toxic component (in ppm)}}{\text{concentration of toxic component (in decimal percent)}}$$

$$\text{Calculated } LC_{50} (1\% \text{ fluorine mix}) = 18,500 \text{ ppm}$$

SECTION 11. TOXICOLOGICAL INFORMATION (Continued)

IRRITANCY OF PRODUCT: This gas mixture may be mildly to moderately 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 and respiratory sensitizers.

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

Mutagenicity: The components of this gas mixture are not reported to cause mutagenic effects in humans.

Embryotoxicity: The components of this gas mixture are not reported to cause embryotoxic effects in humans.

Teratogenicity: The components of this gas mixture are not reported to cause teratogenic effects in humans.

Reproductive Toxicity: The components of this gas mixture are not reported 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, Nitrogen and Xenon are inert and do not degrade. 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 corrosive and 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: EC₅₀ (*Lemna minor* duckweed) 4 weeks = > 60,000 µg/L

EFFECT OF CHEMICAL ON AQUATIC LIFE: The Fluorine component of this gas mixture can be detrimental to aquatic life. If a large release 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 component of this gas mixture:

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

MOBILITY: Argon, Helium, Krypton, Neon, Nitrogen and Xenon 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.

PERSISTENCE AND BIODEGRADABILITY: Persistence: Argon, Helium, Krypton, Neon, Nitrogen and Xenon 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 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 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, nitrogen) or (fluorine, neon) or (fluorine, helium) or (fluorine, argon) or (fluorine, krypton) or (fluorine, xenon)

HAZARD CLASS NUMBER and DESCRIPTION:

2.2 (Compressed 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).

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SECTION 14. TRANSPORT INFORMATION (Continued)

U.S. SHIPPING INFORMATION (continued):

CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas 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.

UN IDENTIFICATION NUMBER: UN 1956
 PROPER SHIPPING NAME: Compressed gas, n.o.s. (fluorine, nitrogen) *or* (fluorine, neon) *or* (fluorine, helium) *or* (fluorine, argon) *or* (fluorine, krypton) *or* (fluorine, xenon)
 HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Compressed Gas)
 PACKING GROUP: Not Applicable
 HAZARD SHIPPING LABEL(S) REQUIRED: Class 2.2 (Compressed Gas)
 SPECIAL PROVISIONS: None
 EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX: 0.125 (SOR/2002-306)
 ERAP INDEX: 3000
 PASSENGER CARRYING SHIP INDEX: Forbidden
 PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX: Forbidden

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA) - IATA DESIGNATION:

This gas mixture is classified as dangerous goods, per the International Air Transport Association.

UN IDENTIFICATION NUMBER: UN 1956
 PROPER SHIPPING NAME: Compressed gas, n.o.s. (fluorine, nitrogen) *or* (fluorine, neon) *or* (fluorine, helium) *or* (fluorine, argon) *or* (fluorine, krypton) *or* (fluorine, xenon)
 HAZARD CLASS NUMBER and DESCRIPTION: 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: A124
 ERG CODE: 2L

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO): IMO DESIGNATION: This gas mixture is classified as dangerous goods, per the International Maritime Organization.

UN No.: 1956
 PROPER SHIPPING NAME: Compressed gas, n.o.s. (fluorine, nitrogen) *or* (fluorine, argon) *or* (fluorine, helium) *or* (fluorine, neon) *or* (fluorine, krypton) *or* (fluorine, xenon)
 HAZARD CLASS NUMBER: 2.2
 PACKING GROUP: None
 SPECIAL PROVISIONS: 274, 292
 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 Marine Pollutants.

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 gas, n.o.s. (fluorine, nitrogen) *or* (fluorine, argon) *or* (fluorine, helium) *or* (fluorine, neon) *or* (fluorine, krypton) *or* (fluorine, xenon)
 CLASS: 2
 CLASSIFICATION CODE: 1A
 PACKING GROUP: Not Applicable
 LABELS: 2.2
 SPECIAL PROVISIONS: 274, 292, 567
 LIMITED QUANTITIES: LQ01
 PACKING INSTRUCTIONS: P200
 MIXED PACKING PROVISIONS: MP7
 HAZARD IDENTIFICATION No.: 26

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 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

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

All components 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.

CANADIAN FEDERAL REGULATIONS:

CANADIAN DSL/NDL 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, D2B as per the Controlled Product Regulations. Argon, Helium, Krypton, Neon, Nitrogen and Xenon 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 D2B: Materials Causing Other Toxic Effects

**EUROPEAN ECONOMIC COMMUNITY REGULATIONS:**

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

EU CLASSIFICATION: Xn (Harmful)

EU RISK PHRASES: [R: 20/21]: Harmful by inhalation and in contact with skin. [R: 36/37/38]: Irritating to eyes, respiratory system and skin.

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: 7/9]: Keep container tightly closed and in a well ventilated place. [S: 17]: Keep away from combustible material. [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).

EU ANNEX II HAZARD SYMBOL:



SECTION 15. REGULATORY INFORMATION (Continued)

EUROPEAN COMMUNITY INFORMATION FOR COMPONENTS:**ARGON, HELIUM, KRYPTON, NEON, NITROGEN AND XENON:**

EU CLASSIFICATION: Official classification for these substances have not been published in Commission Directives.

FLUORINE: The following classification has been published in Commission Directives for Fluorine.

EU CLASSIFICATION: T+ (Very Toxic); C (Corrosive)

EU RISK PHRASES: [R: 7]: May cause fire. [R: 36]: Very toxic by inhalation. [R: 35]: Causes severe burns.

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: 7/9]: Keep container tightly closed and in a well ventilated place. [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).

GLOBAL HARMONIZATION SYSTEM WARNINGS:**HAZARD CATEGORIES:**

Compressed Gas
Acute Toxicity Inhalation Category 4
Acute Toxicity Skin Category 4
Skin Corrosion/Irritation Category 2
Serious Eye Damage/Irritation 2A
Specific Target Organ Systemic Toxicity (Single Exposure/Repeated Exposure) Category 2

SIGNAL WORDS:

Warning

HAZARD STATEMENTS:

Contains gas under pressure; may explode if heated.

Harmful if inhaled.

Harmful in contact with skin.

Causes skin irritation in presence of moisture.

Causes serious eye irritation.

PREVENTION STATEMENTS:

Do not eat, drink or smoke when using this gas. Wash hands thoroughly after using. Avoid breathing gas.

Use only outdoors or in a well-ventilated place. Avoid breathing gas.

STORAGE:

Store locked-up, protect from sunlight and store in well-ventilated place. Keep valves tightly closed.

RESPONSE STATEMENTS:

In case of fire, stop leak if it is safe to do so.

If inhaled: remove to fresh air and keep at rest in a comfortable position. Call a POISON CENTER or doctor/physician if exposed or if you feel unwell.

If skin or eye irritation occurs, get medical advice/attention.

If in eyes, rinse with water cautiously for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. If eye irritation persists, get medical advice/attention. Wash hands after handling.

DISPOSAL STATEMENTS:

Reclaim/recycle/dispose of contents and cylinder per local, regional, national and international regulations.

SYMBOLS:

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.

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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Revision history:

4/20/09: Review and up-date of entire MSDS and addition of Global Harmonization classification.