SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards, and the Global Harmonization Standard

1. SECTION 1 – IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

CHEMICAL NAME; CLASS: 1,1-DIFLUOROETHYLENE

SYNONYMS: Refrigerant Gas R 1132a; Difluoro-1,1-ethylene; Ethene, 1,1-difluoro-; Vinylidene Difluoride
CHEMICAL FAMILY: Halogenated Aliphatic Hydrocarbon
FORMULA: $C_2H_2F_2$

	Document Number: 80030
PRODUCT USE:	Various
MANUFACTURED/SUPPLIED FOR:	
SUPPLIER/MANUFACTURER'S NAME:	AIR LIQUIDE AMERICA
ADDRESS:	2700 Post Oak Drive Houston, TX 77056-8229
EMAIL ADDRESS FOR PRODUCT INFORMATION:	webmaster.us@airliquide.com
EMERGENCY PHONE:	CHEMTREC: (U.S., Canada) 1-800-424-9300 (24 hrs) (International) +703-527-3887 (collect-24 hrs)
BUSINESS PHONE:	General SDS Information: 1-713/896-2896 (8 am to 5 pm U.S. Central Time) Fax on Demand: 1-800/231-1366

ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2010 format. This gas mixture has been classified in accordance with the hazard criteria of the CPR and the SDS contains all the information required by the CPR. The product is also classified per the Global Harmonization Standard.

2. HAZARD IDENTIFICATION

GLOBAL HARMONIZATION LABELING AND CLASSIFICATION: This gas mixture has been classified per GHS Standards.
Classification: Gases Under Pressure, Flammable Gas Cat. 1, Carcinogenic Cat. 2
Signal Words: Danger
Hazard Statement Codes: H220, H280, H351
Precautionary Statement Codes: P210, P201, P202, P308 + P313, P377, P381, P410 + P403, P405, P501
Hazard Symbols/Pictograms: GHS02, GHS04, GHS08

See Section 16 for a full definition of classification.

EMERGENCY OVERVIEW: **Product Description: DANGER!** Extremely flammable, liquefied gas. This is a colorless, extremely flammable, liquefied gas with an ethereal odor. **Health Hazards:** The primary health hazard associated with this gas is the potential for severe thermal burns from contact with flames resulting from the ignition of this gas. Depending on the severity of the burns, such exposure can be fatal. Inhalation may cause respiratory irritation. Direct skin or eye contact from rapidly released gas can cause freezing and tissue damage. High concentrations of this gas mixture can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. The skin of a victim of exposure may have a blue color. Under some circumstances of exposure, death may occur. Rapidly expanding gas can cause frostbite. This gas is a suspect carcinogen, based on animal data. **Flammability Hazards:** This gas is extremely flammable and can ignite in the presence of any type of ignition source and can readily form explosive mixtures with air. Releases which have not ignited must be considered extremely dangerous, and should not be approached. This gas is heavier than air and can accumulate in low-lying spaces, creating an extreme fire hazard and hazard of oxygen-deficient atmosphere. When involved in a fire, this gas will decompose to produce toxic fumes including hydrogen fluoride, fluorine, and fluorides. **Reactivity Hazards:** This gas may readily undergo violent chemical change at elevated temperatures and pressures. This gas may polymerize releasing a large amount of heat, with fire or explosion hazard. **Environmental Hazards:** This gas may cause harm to terrestrial and aquatic organisms if accidentally released. **Emergency Response Considerations:** Persons who respond to releases of this gas must protect themselves from inhalation of the gas, especially in areas which are downwind of the release.

3. COMPOSITION and INFORMATION ON INGREDIENTS

Chemical Name	CAS #	MOLE %	LABEL ELEMENTS GHS Classification
1,1-Difluoroethylene	75-38-7	100%	SELF CLASSIFICATION Classification: Gases under Pressure, Flammable Gas Cat. 1, Carcinogenic Cat. 2 Hazard Statement Codes: H220, H280, H351 Hazard Symbols/Pictograms: GHS02, GHS04, GHS08

See Section 16 for full text of classification.

4. FIRST-AID MEASURES

PROTECTION OF FIRST AID RESPONDERS: RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant clothing must be worn. Adequate fire protection must be provided during rescue situations. Rescuers should be taken for medical attention, if necessary. Victim(s) must be taken for medical attention. Take copy of label and SDS to physician or other health professional with victim(s).

DESCRIPTION OF FIRST AID MEASURES: Remove victim(s) to fresh air, as quickly as possible. 100% oxygen should be administered to victims of exposure to this gas as soon as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Remove and isolate contaminated clothing and shoes. Seek immediate medical attention. Take copy of label and SDS to physician or other health professional with victim(s).

Thermal Burns: In the event personnel are burned as a result a release of this product, if burns are first degree or second degree with closed blisters, flush area with cold water until pain subsides. Apply loose, moist, sterile dressings, and bandage. Treat for shock. If burns are second degree with open blisters or third degree, apply loose, dry, sterile dressings and bandage. Treat for shock. Transport victim immediately to hospital or emergency center. Burns over an area of 20% or more of body are life-threatening; medical attention should be immediately sought.

Inhalation Exposure: If inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Do not use mouth-to-mouth method; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Seek immediate medical attention.

Skin Exposure: If this gas contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 20 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention. Remove any clothing that may restrict circulation to any frozen area. Do not rub frozen parts as tissue damage may occur. As soon as practicable, place any affected area in warm water bath which has a temperature that does not exceed 105°F (40°C). NEVER USE HOT WATER. NEVER USE DRY HEAT. If area of frostbite is extensive, and if possible, remove clothing while showering with warm 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 of the body in the armpit. Encourage victim to gently exercise the affected part while being warmed. Frozen tissue is painless and appears waxy, with a possible yellow color. Frozen tissue will become swollen, painful and prone to infection when thawed. If the frozen part of the body has been thawed by the time medical attention has been obtained, cover the area with a dry sterile dressing and a large bulky protective covering.

Eye Exposure: If this gas enters 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.

IMPORTANT SYMPTOMS AND EFFECTS (Acute and Chronic/Delayed): See Sections 2 (Hazard Identification) and 11 (Toxicological Information).

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE Skin conditions and respiratory disorders may be aggravated by exposure to this product and its decomposition products.

IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED: Treat symptoms and reduce over-exposure.

5. FIRE-FIGHTING MEASURES

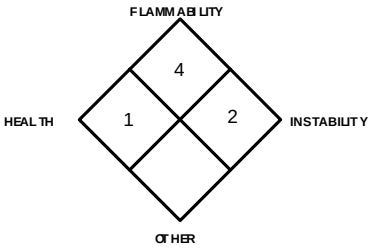
FLASH POINT: Extremely flammable gas.

AUTOIGNITION TEMPERATURE: 640°C (1184°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 5.5% Upper (UEL): 21.3%

NFPA RATING



FIRE EXTINGUISHING MEDIA: Extinguish fires of this gas by shutting-off the source of the gas. Use a flooding quantity of water as a spray. Cool fire-exposed cylinders with water spray, from the maximum distance possible. Carbon Dioxide and dry chemical can also be used to extinguish fires of gas.

UNSUITABLE FIRE EXTINGUISHING MEDIA: Do not use halocarbon-type fire extinguishing agents.

SPECIFIC HAZARDS ARISING FROM THE MIXTURE: DANGER! This gas is extremely flammable and can ignite in the presence of any type of ignition source and can readily form explosive mixtures with air. Releases which have not ignited must be considered extremely dangerous, and should not be approached. When involved in a fire, this gas will decompose to produce toxic fumes including hydrogen fluoride, fluorine, and fluorides.

This gas readily forms explosive mixtures with air over a very wide range. If released into a confined space, an extreme fire hazard exists. This gas is colder and/or heavier than air and may hug the ground and can travel a considerable distance to a source of ignition and flash back to leaking cylinder. Fires impinging (direct flame) on the outside surface of unprotected cylinders of this product can be very dangerous. Direct flame exposure on the cylinder wall can cause a catastrophic failure of the cylinder releasing the contents into a massive fireball and explosion. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn. Uninhibited gas may form polymers in the vents or flame arresters causing blockage.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: This gas readily forms explosive mixtures with air, which are easily ignited by an electrostatic discharge.

5. FIRE-FIGHTING MEASURES

SPECIAL PROTECTIVE ACTIONS FOR FIRE-FIGHTERS: Above 52°C (125.6°F) closed containers may rupture violently. Ruptured cylinders may rocket. Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Appropriate chemically-protective clothing may be necessary. Keep away from low-lying areas. Stay upwind. Because of the potential for a cylinder rupture during a fire, evacuation of non-emergency personnel is essential. If water is not available for cooling or protection of cylinder exposure, evacuate the area. Follow the guidelines of the North American Emergency Response Guidebook (Guide #119). If possible to do so without endangering personnel, shut off the flow of gas supporting the fire. Immediately cool the cylinders with water spray from a maximum distance. When cool, move cylinders from fire area if this can be done without risk to firefighters. Reverse flow into cylinder may cause rupture. Take care not to block pressure relief valves. Stay away from ends of tanks (but realize that shrapnel may travel in any direction). Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. In an advanced or massive fire, the area should be evacuated; use unmanned hose-holders or monitor nozzles. Do not enter without wearing specialized protective equipment suitable for the situation. If this gas is involved in a fire, run-off water should be contained to prevent possible environmental damage.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS AND EMERGENCY PROCEDURES: EVACUATE IMMEDIATE AREA. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Monitor the surrounding area for combustible vapor levels. Combustible vapor levels must be below 10% of the LEL for this gas (LEL = 5.5%) before personnel are permitted to enter the area. If necessary, ventilate area.

PERSONAL PROTECTIVE EQUIPMENT:

All Releases: Minimum Personal Protective Equipment should be **Level A: triple-gloves (rubber gloves and nitrile gloves, over latex gloves), fully-encapsulating chemically resistant suit and boots, hard-hat, and Self Contained Breathing Apparatus.** The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus.

METHODS FOR CLEAN-UP AND CONTAINMENT:

Small Releases: Small leaks can be detected by means of an atomizer or squeeze bottle filled with soap solution. Small bubbles will show the location of the leak. Follow procedures for clean-up given under 'All Spills' below.

All Spills: Attempt to close the main source valve prior to entering the area. If this does not stop the release (or it is not possible to reach the valve), allow the gas to release in place or remove it to a safe area and allow the gas to be released there. Never apply water to a leak of this gas. Monitor the surrounding area for combustible gas levels and oxygen levels.

ENVIRONMENTAL PRECAUTIONS: Avoid release to the environment. Run-off water may be contaminated by other materials and should be contained to prevent possible environmental damage.

REFERENCE TO OTHER SECTIONS: See information in Section 8 (Exposure Controls – Personal Protection) and Section 13 (Disposal Considerations) for additional information.

7. HANDLING and USE

PRECAUTIONS FOR SAFE HANDLING: All employees who handle this gas should be trained to handle it safely. Minimize all exposure to this gas. Non-sparking tools should be used. Do not attempt to repair, adjust, or in any other way modify the cylinders containing this gas. If there is a malfunction, or another type of operational problem, contact nearest distributor immediately. Working alone with this gas should be avoided when possible. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. All areas where this gas is used should be monitored with gas detection instruments. Detection of any release should trigger immediate response and corrective action, with an alarm calling for evacuation of all personnel with the potential to be exposed. Avoid all contact with this gas. All employees who handle this gas should be trained to handle it safely. Avoid breathing gas. Wash hands after handling chemicals. Do not eat or drink while handling chemicals. All work practices should minimize the release of this gas. Be aware of any signs of dizziness or fatigue; exposure to fatal concentrations of this gas could occur without any significant warning symptoms, due to oxygen deficiency. Use a check valve in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders. Any proposed use of this gas in elevated-temperature processes should be thoroughly evaluated to ensure that safe operating conditions are established and maintained. Periodic inspections of process equipment by knowledgeable persons should be made to ensure that the equipment is used appropriately and the system is kept in suitable operating condition. Emergency response equipment should be available near the point of use.

- Workers who handle this gas should wear protective clothing, as given in Section 8 (Exposure Controls and Personal Protection).
- Instant-acting showers should be available in the event of an emergency.
- Special eye-wash fountains or similar equipment should be available for eye irrigation.
- Proper respiratory protection equipment must be provided and workers using such equipment must be carefully trained in its operation and limitations.
- Precautions must always be taken to prevent suck-back of foreign materials into the cylinder by using a check-valve, or vacuum break, since suck-back may cause dangerous pressure changes within the cylinder.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Compressed gases can present significant safety hazards. The following rules are applicable to work situations in which cylinders are being used.

Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap (where provided) in-place until cylinder is ready for use.

7. HANDLING and USE (Continued)

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS (continued):

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Do not use oils or grease on gas-handling fittings or equipment. Immediately contact the supplier if there are any difficulties associated with operating cylinder valve. Never insert an object (e.g., wrench, screwdriver, pry bar, 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. Never strike an arc, on a compressed gas cylinder or make a cylinder part of and electric circuit.

After Use: Close main cylinder valve. Replace valve protection cap. Mark empty cylinders "EMPTY".

CONDITIONS FOR SAFE STORAGE: Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. at www.cganet.com pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers.* Local regulations may require specific equipment for storage and use. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked-over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Cylinders should be stored in dry, well-ventilated areas away from sources of heat, ignition and direct sunlight. Keep storage area clear of materials which can burn. Do not allow area where cylinders are stored to exceed 52°C (125°F). Store containers away from heavily trafficked areas and emergency exits. Store away from process and production areas, away from elevators, building and room exits or main aisles leading to exits. Protect cylinders against physical damage. Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals, such as strong oxidizers, metals, and metal oxides (refer to Section 10, Stability and Reactivity, for more information). Storage areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs in storage or use areas. Consider installation of leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment in the storage area (i.e. sprinkler system, portable fire extinguishers). Keep the smallest amount on-site as is necessary.

NOTE: Use only DOT or ASME code containers designed for flammable gas storage. Close valve after each use and when empty. Earth-ground and bond all lines and equipment associated with this gas.

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA: Use the proper CGA connections, DO NOT USE ADAPTERS: STANDARD: CGA 350; DISS: CGA 632

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

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT (continued): Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (i.e. argon) before attempting repairs. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/CONTROL PARAMETERS:

Ventilation and Engineering Controls: Because of the high hazard associated with this gas, stringent control measures such as a gas cabinet enclosure or isolation may be necessary. Use a non-sparking, grounded, explosion-proof ventilation system separate from other exhaust ventilation systems. Ductwork should be constructed of non-metallic material, or should be lined to resist corrosion. If appropriate, install automatic monitoring equipment to detect the level of the gas.

Occupational/Workplace Exposure Limits/Guidelines:

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR							
		ACGIH-TLVs		OSHA-PELs		NIOSH-RELs		NIOSH	OTHER
		TWA ppm	STEL ppm	TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	
1,1-Difluoroethylene	75-38-7	500	NE	NE	NE	See Pocket Guide Appendix A Use 29 CFR 1910.1017	5 (ceiling)	NE	Carcinogen: IARC-3, MAK-3B, TLV-A4

NE = Not Established

International Exposure Limits: Currently, the following international exposure limits are in force for this gas.

1,1-DIFLUOROETHYLENE:

Belgium: TWA = 500 ppm (1330 mg/m^3), MAR 2002

PROTECTIVE EQUIPMENT: *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, including* U.S. Federal OSHA Respiratory Protection (29 CFR 1910.134), OSHA Eye Protection 29 CFR 1910.133, OSHA Hard Protection 29 CFR 1910.138, OSHA Foot Protection 29 CFR 1910.136 and OSHA Body Protection 29 CFR1910.132)*, equivalent standards of Canada (including CSA Respiratory Standard Z94.4-02,* Z94.3-M1982, *Industrial Eye and Face Protectors and* CSA Standard Z195-02, *Protective Footwear). Please reference applicable regulations and standards for relevant details.*

Respiratory Protection: Maintain exposure levels of this gas below 50% of the recommended TLV (500 ppm) and oxygen levels above 19.5% in the workplace. The use of supplied air respiratory protection is recommended when changing cylinders or working on systems containing this gas. Use supplied air respiratory protection when gas levels exceed 50% of the TLV or oxygen levels are below 19.5%, or during emergency response to a release of this product. During an emergency situation, before entering the area, check the concentration of this gas and oxygen.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

PROTECTIVE EQUIPMENT (continued):

Respiratory Protection (continued): If necessary, use only respiratory protection authorized under appropriate regulations. In the U.S., oxygen levels below 19.5% are considered IDLH by U.S. OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard. The following are NIOSH Respiratory Protection Guidelines for this gas.

1,1-DIFLUOROETHYLENE

CONCENTRATION	RESPIRATORY PROTECTION
Up to 10 ppm:	Any Air-Purifying Half-Mask Respirator equipped with organic vapor cartridge(s) or any Supplied Air Respirator (SAR).
Up to 25 ppm:	Any SAR operated in a continuous-flow mode or any Powered Air-Purifying Respirator (PAPR)with organic vapor cartridge(s).
Up to 50 ppm:	Any Air-Purifying Full-Facepiece Respirator equipped with organic vapor cartridge(s) or any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister or any PAPR with a tight-fitting facepiece and organic vapor cartridge(s) or any Self-Contained Breathing Apparatus (SCBA) with a full facepiece or any SAR with a full facepiece.
Up to 200 ppm:	Any SAR that has a full facepiece and is operated in a pressure-demand or other positive pressure mode.
Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions:	Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or any SAR that has a full-facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.
Escape:	Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister or any appropriate escape-type, SCBA.

Eye Protection: Splash goggles or safety glasses, with a face shield for additional protection. If necessary, refer to appropriate regulations for further information.

Hand Protection: Wear leather gloves when handling cylinders of this product. Wear appropriate gloves for industrial use. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this SDS. If necessary, refer to appropriate regulations.

Body Protection: When chemical contact is possible, use splash apron, work uniform, and shoes or coverlets to prevent skin contact. Full-body chemical protective clothing is recommended for emergency response procedures. For emergency response operations, clothing resistant to the toxic effects of this gas is required. If necessary, refer to the U.S. OSHA Technical Manual (Section VII: Personal Protective Equipment) or other appropriate regulations. 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 appropriate regulations.

9. PHYSICAL and CHEMICAL PROPERTIES

FORM: Liquefied gas.
COLOR: Colorless.
MOLECULAR FORMULA: $C_2H_2F_2$
MOLECULAR WEIGHT: 64.04 g/mol
ODOR: Faint, ethereal.
ODOR THRESHOLD: Not available.
SPECIFIC GRAVITY @ 24°C (air = 1): 0.617 g/cc
SPECIFIC VOLUME: 6.22 ft^3/lb
FREEZING POINT: -144.0°C (-227°F)
BOILING POINT: -83°C (-117°F)
GAS DENSITY @ 25°C: 0.617 g/mL
VAPOR DENSITY (air = 1): 2.21
LIQUID DENSITY @ 20°C: 670 kg/m^3
VAPOR PRESSURE @ 20°C: 3.59 MPa
VISCOSITY: 7.7574 pascal-seconds (liquid) at boiling point
VAPOR PRESSURE @ 21.1°C: 532 psia
FLASH POINT: Extremely flammable.
AUTOIGNITION: 640°C (1184°F)
LOWER FLAMMABILITY LIMIT (LEL): 5.5%
UPPER FLAMMABILITY LIMIT (UEL): 21.3%
CRITICAL TEMPERATURE: 29.75-30.1°C (85.5-86.2°F)
pH: Not applicable.
CRITICAL PRESSURE @ 30.1°C: 43.8 atm (4.46 MPa)
EXPANSION RATIO: Not available.
EVAPORATION RATE (nBuAc = 1): Not applicable.
SOLUBILITY IN WATER: Insoluble.

OTHER SOLUBILITIES: Soluble in ethanol; very soluble in diethyl ether.

COEFFICIENT WATER/OIL DISTRIBUTION: Log Kow = 1.24

HOW TO DETECT THIS SUBSTANCE (identification properties): The odor may be a distinctive warning property of associated with this gas.

10. STABILITY and REACTIVITY

CHEMICAL STABILITY: Violent reaction with hydrogen chloride when heated under pressure. Uninhibited gas may form polymers in the vents or flame arresters causing blockage.

DECOMPOSITION PRODUCTS: *Combustion:* Thermal decomposition produces hydrogen fluoride, fluorine, and fluorides. *Hydrolysis:* None known.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: A very dangerous fire hazard when exposed to heat, flame, or oxidizers; explosive in the form of vapor when exposed to heat or flame. Violent reaction with hydrogen chloride when heated under pressure. Incompatible with aluminum chloride.

POSSIBILITY OF POLYMERIZATION OR OTHER HAZARDOUS REACTION: Polymerization will not occur. Reacts very violently when heated under confinement.

10. STABILITY and REACTIVITY (Continued)

CONDITIONS TO AVOID: Avoid contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of exposure to this gas are by inhalation, eye and skin contact.

Inhalation: Low concentrations of this gas may be irritating to mucous membranes of the respiratory system. At higher concentrations the gas can ignite, causing a risk of thermal burns. High concentrations can cause an oxygen-deficient environment, especially if released in a poorly-ventilated area (e.g., an enclosed or confined space). Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of exposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increase, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

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

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	1*
FLAMMABILITY HAZARD	(RED)	4
PHYSICAL HAZARD	(YELLOW)	2

PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
	SEE SECTION 8		SEE SECTION 8

For Routine Industrial Use and Handling Applications

Contact with Skin or Eyes: Exposure to low concentrations of this gas can be irritating to the eyes and skin. Rapidly released gas can cause cold burns to the eyes and may cause blindness. At higher concentrations this gas may ignite, causing a risk of thermal burns.

Skin Absorption: Not a significant route of exposure.

Ingestion: Not a significant route of exposure.

Other Potential Health Effects: Another health hazard presented by this is that it may ignite so rapidly, personnel in the area of a release can receive severe thermal burns. Depending on the severity of the burns, such exposure can be fatal.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Exposure to this gas mixture may cause the health effects described below.

Acute: Though unlikely to occur under normal circumstances, inhalation of high concentrations of this gas may cause headache, nausea, and irritation of the upper respiratory tract. Exposure to high concentrations may result in thermal burns due to the pyrophoric nature of the gas.

Chronic: Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system.

TARGET ORGANS: Acute: Respiratory system, skin, eyes. Chronic: Heart, central nervous system.

TOXICITY DATA: Currently, the following toxicity data are available for this gas.

1,1-DIFLUOROETHYLENE:

LC_{50} (Inhalation-Rat) 240,000 mg/m^3/4 hours
LCLo (Inhalation-Rat) 128,000 ppm/4 hours: Lungs, Thorax, or Respiration: other changes
LCLo (Inhalation-Guinea Pig) 800 ppb/4 hours
TCLo (Inhalation-Rat) 1500 ppm/6 hours/13 weeks-intermittent: Liver: changes in liver weight; Kidney/Ureter/Bladder: changes in bladder weight; Blood: changes in erythrocyte (RBC) count
TCLo (Inhalation-Mouse) 40,000 ppm/6 hours/13 weeks-intermittent: Behavioral: excitement; Blood: pigmented or nucleated red blood cells; Skin and Appendages: hair
TDLo (Oral-Rat) 1930 mg/kg/52 weeks-intermittent: Tumorigenic: neoplastic by RTECS criteria; Sense Organs and Special Senses (Ear): effect, not otherwise specified; Skin and Appendages: tumors
TDLo (Oral-Rat) 857 mg/kg/130 weeks-intermittent: Tumorigenic: equivocal tumorigenic agent by RTECS criteria; Skin and Appendages: tumors
Mutation in Microorganisms (Bacteria-*Salmonella typhimurium*) 50 pph/24 hours

OTHER ANIMAL TOXICITY DATA: Acute inhalation toxicity was evaluated in groups of male and female Charles River CD rats (5/sex/concn level) exposed to 1,1-Difluoroethylene at a concentration of 800,000 ppm (80% v/v) in a glass inhalation exposure chamber for 6 hrs. All animals exhibited signs of deep, rapid, labored breathing and lethargy after termination of one hour of exposure. 7 of the 10 animals died after 4 1/2 hrs of exposure. After 6 hrs of exposure, only 3 females had survived. One hour after termination of exposure, the survivors appeared normal and exhibited no other signs of toxicity during the 14 day observation period. Gross necropsy of the animals which died during exposure revealed dark red areas in all lobes of the lungs. The liver of all 7 deceased animals showed pale areas, and one male rat had pale kidneys. All other tissues appeared normal. The three surviving female rats also showed dark red areas in all lobes of the lungs.

11. TOXICOLOGICAL INFORMATION (Continued)

CARCINOGENIC POTENTIAL: In one limited study using rats exposed orally, a small number of liposarcomas were observed in treated animals. This gas is a suspect carcinogen and is listed by agencies the carcinogenic effects of chemical compounds as follows:

ACGIH TLV-A4 (Not Classifiable as a Human Carcinogen); IARC-3 (Unclassifiable as to Carcinogenicity in Humans); DFG MAK 3B (Substances for Which in vitro tests or animal studies have yielded evidence of carcinogenic effects that is not sufficient for classification of the substance in one of the other categories. Further studies are required before a final classification can be made.)

IRRITANCY OF PRODUCT: This gas may be irritating to exposed tissues.

SENSITIZATION TO THE PRODUCT: This gas is not known to be a human skin or respiratory sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: Currently, there is no information on the potential human mutagenic, embryotoxic, teratogenic or reproductive effects of this gas. The following animal information is available.

Mutagenicity: In the Ames test at a concentration up to 50% there were positive mutagenic results in TA1535 only, from 10%, with S9, 1.6-2.6 times spontaneous frequency in 7 trials and negative results in TA1537, TA98, TA100 up to 50% with or without S9. In studies involving Chinese hamster ovary the assay for chromosome aberrations were negative (concentration tested up to 100%). 1,1-Difluoroethylene vapors (50% v/v in air for 24 hr) induced a marginal increase in the number of revertants in *Salmonella typhimurium* TA100 in the presence of a metabolic system from the liver of phenobarbital induced mice. Other tests for Drosophila sex-linked recessive lethal (SLRL) test, cell transformation, *in vivo* micronucleus assay and cell transformation were negative.

Embryotoxicity/Teratogenicity/Reproductive Toxicity: Sprague-Dawley rat, inhalation at 0-5 days (pregnancy) 2 weeks (mating period) for 6 hours/day, 7 days/week (mating period) or 5 days/week (pre-mating period). Pre-mating exposure period, 15 weeks for males and females at 250, 1,000, or 7,000 ppm. No effect on fertility, ovary weight, litter data, reproductive male organ weight.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, no Biological Exposure Indices (BEIs) have been determined for this gas.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

MOBILITY: Using a structure estimation method based on molecular connectivity indices, the Koc of 1,1-Difluoroethene can be estimated to be 32. According to a classification scheme, this estimated Koc value suggests that 1,1-Difluoroethene is expected to have very high mobility in soil.

PERSISTENCE AND BIODEGRADABILITY: If released to air, a vapor pressure of 3X10+4 mm Hg at 25°C indicates 1,1-Difluoroethene will exist solely as a gas in the atmosphere. Gas-phase 1,1-Difluoroethene will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals and with ozone; the half-life for these reactions in air are estimated to be 8 and 60 days, respectively. 1,1-Difluoroethene does not contain chromophores that absorb at wavelengths > 290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight. If released to soil, 1,1-Difluoroethene is expected to have very high mobility based upon an estimated Koc of 32. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 0.4 atm-cu m/mole. 1,1-Difluoroethene may volatilize from dry soil surfaces based upon its vapor pressure. Insufficient data are available to predict the relative importance or rate of biodegradation in soil or water. If released into water, 1,1-Difluoroethene is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Volatilization from water surfaces is expected to be an important fate process based upon this compound's estimated Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 2.3 hours and 3.2 days, respectively. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions.

BIO-ACCUMULATION POTENTIAL: An estimated BCF of 3 was calculated in fish for 1,1-Difluoroethene, using a log Kow of 1.24 and a regression-derived equation. According to a classification scheme, this BCF suggests the potential for bioconcentration in aquatic organisms is low.

ECOTOXICITY: All release to terrestrial, atmospheric and aquatic environments should be avoided as this gas can cause harm to terrestrial and aquatic organisms. No aquatic toxicity data are available for this gas.

OTHER ADVERSE EFFECTS: This gas is not expected to have any ozone depletion potential.

ENVIRONMENTAL EXPOSURE CONTROLS: Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

13. DISPOSAL CONSIDERATIONS

PRECAUTIONS TO BE FOLLOWED DURING WASTE HANDLING: Wear proper protective equipment when handling waste materials.

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Air Liquide. Do not dispose of locally. For emergency disposal, secure the cylinder and slowly discharge the gas to the atmosphere in a well-ventilated area or outdoors.

U.S. EPA WASTE NUMBER: D001 (Waste Characteristic-Ignitability)

14. TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION REGULATIONS: This gas is classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

UN IDENTIFICATION NUMBER: UN 1959
PROPER SHIPPING NAME: 1,1-Difluoroethylene *or* Refrigerant Gas R 1132a
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
DOT LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2012): 115
MARINE POLLUTANT: This gas is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

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 1959
PROPER SHIPPING NAME: 1,1-Difluoroethylene *or* Refrigerant Gas R 1132a
HAZARD CLASS and DESCRIPTION: 2.1 (Flammable Gas)
HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
PACKING GROUP: Not Applicable
SPECIAL PROVISION: 38
EXPLOSIVE LIMIT & LIMITED QUANTITY INDEX: 0.125
ERAP INDEX: 3000
PASSENGER CARRYING SHIP INDEX: Forbidden
PASSENGER CARRYING ROAD OR RAIL VEHICLE INDEX: Forbidden
MARINE POLLUTANT: This gas is not listed as a marine pollutant and does not meet the criteria.

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA): This gas is classified as dangerous goods, per the International Air Transport Association. This gas is forbidden for air transport.

UN IDENTIFICATION NUMBER: UN 1959
PROPER SHIPPING NAME: 1,1-Difluoroethylene *or* Refrigerant Gas R 1132a
HAZARD CLASS or DIVISION: 2.1 (Flammable Gas)
HAZARD LABEL(S) REQUIRED: Class 2.1 (Flammable Gas)
PACKING GROUP: Not Applicable
EXCEPTED QUANTITIES: E0
PASSENGER and CARGO AIRCRAFT PACKING INSTRUCTION: Forbidden
PASSENGER and CARGO AIRCRAFT MAXIMUM NET QUANTITY PER PKG: Forbidden
PASSENGER and CARGO AIRCRAFT LIMITED QUANTITY PACKING INSTRUCTION: Forbidden
PASSENGER and CARGO AIRCRAFT LIMITED QUANTITY MAXIMUM NET QUANTITY PER PKG: Forbidden
CARGO AIRCRAFT ONLY PACKING INSTRUCTION: 200
CARGO AIRCRAFT ONLY MAXIMUM NET QUANTITY PER PKG: 150 kg
SPECIAL PROVISIONS: A1
ERG CODE: 10L

TRANSPORT IN BULK ACCORDING TO THE IBC CODE: See the information under the individual jurisdiction listings for IBC information.

ENVIRONMENTAL HAZARDS: This gas does not meet the criteria of environmentally hazardous according to the criteria of the UN Model Regulations (as reflected in the IMDG Code, ADR, RID, and ADN); this gas is not specifically listed in Annex III under MARPOL 73/78.

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA Reporting Requirements: This gas is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA Section 302 Extremely Hazardous Threshold Planning Quantity (TPQ): There are no specific Threshold Planning Quantities for this gas. The default Federal SDS submission and inventory requirement filing threshold of 10,000 lbs (4,540 kg) therefore applies, per 40 CFR 370.20.

U.S. SARA Section 304 Extremely Hazardous Reportable Quantity (RQ): Not applicable.

U.S. CERCLA Reportable Quantity (RQ): Not applicable.

U.S. TSCA Inventory Status: This gas is listed on the TSCA Inventory.

U.S. SARA Hazard Categories (Section 311/312, 40 CFR 370-21): ACUTE: Yes; CHRONIC: No; FIRE: Yes; REACTIVE: Yes; SUDDEN RELEASE: Yes

Other U.S. Federal Regulations: Not applicable.

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65): This gas is not on the California Proposition 65 lists.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS:

Canadian DSL Inventory Status: This gas is not listed on the DSL or NDSL Inventories.

Canadian Environmental Protection Act (CEPA) Priorities Substances Lists: This gas is not listed on the CEPA Priority Substances List.

Canadian WHMIS Regulations: This gas is classified as a Controlled Product, Hazard Classes A, B1, D2B and F, as per the Controlled Product Regulations.

16. OTHER INFORMATION

GLOBAL HARMONIZATION AND EU CLP REGULATION (EC) 1272/2208 LABELING AND CLASSIFICATION: Classified in accordance with CLP Regulation (EC) 1272/2008. This is a self-classification. For information on classification under (67/548/EEC), see below.

Classification: Gases under Pressure, Flammable Gas Category 1, Carcinogenic Category 2

Signal Words: Danger

Hazard Statements: H280: Contains gas under pressure; may explode if heated. H220: Extremely flammable gas. H351: Suspected of causing cancer.

Prevention Statements:

Precautionary: P210: Keep away from heat/sparks/open flames/hot surfaces. — No smoking. P201: Obtain special instructions before use. P202: Do not handle until all safety precautions have been read and understood.

Response: P308 + P313: IF exposed or concerned: Get medical advice/attention. P377: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. P381: Eliminate all sources of ignition if it is safe to do so. P370 + P378: In case of fire: Use materials appropriate for surrounding fire for extinction. P381: Eliminate all sources of ignition if it is safe to do so.

Storage: P410 + P403: Protect from sunlight. Store in a well-ventilated place. P405: Store locked up.

Disposal: P501: Dispose of contents/containers in accordance with all local, regional, national and international regulations.

Hazard Symbol: GHS02, GHS04, GHS08

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information about gas mixtures can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 4221 Wainey Road, 5th Floor, Chantilly, VA 20151-2923 Telephone: (703) 788-2700.

P-1 *"Safe Handling of Compressed Gases in Containers"*
AV-1 *"Safe Handling and Storage of Compressed Gases"*
"Handbook of Compressed Gases"

REFERENCES AND DATA SOURCES: Contact the supplier for information.

METHODS OF EVALUATING INFORMATION FOR THE PURPOSE OF CLASSIFICATION: As a pure chemical, specific data available were used in order to classify this gas.

REVISION DETAILS: New.

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 1961, Hilo, HI 96721 • (800) 441-3365 (808) 969-4846
Fax on Demand**:** 1-800/231-1366

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