



MATERIAL SAFETY DATA SHEET

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

1. PRODUCT AND COMPANY INFORMATION

CHEMICAL NAME; CLASS: SULFUR HEXAFLUORIDE

SYNONYMS: Sulfur Fluoride

CHEMICAL FAMILY NAME: Inert Gas

FORMULA: SF₆

PRODUCT USE:

Document Number: 20153
Gaseous dielectric; plasma etching, leak detection; limited medical uses.

**MANUFACTURED/SUPPLIED FOR:
ADDRESS:**



2700 Post Oak Drive
Houston, TX 77056-8229

EMERGENCY PHONE:

CHEMTREC: 1-800-424-9300

BUSINESS PHONE:

General MSDS Information 1-713/896-2896
Fax on Demand: 1-800/231-1366

2. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Sulfur Hexafluoride is a colorless, odorless, non-toxic, nonflammable, liquefied gas. The main health hazard associated with releases of this gas is asphyxiation, by displacement of oxygen. The liquefied gas will rapidly boil at standard temperatures and pressures. This product is not flammable or reactive under typical emergency response situations.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this gas is by inhalation.

INHALATION: High concentrations of this gas 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.

Under some circumstances of over-exposure, death may occur, due to the displacement of oxygen. The following effects associated with various levels of oxygen are as follows:

<u>CONCENTRATION</u>	<u>SYMPTOM OF EXPOSURE</u>
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea and vomiting, collapse or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

An additional inhalation hazard can occur if Sulfur Hexafluoride is subjected to electrical discharge. Under this event Sulfur Hexafluoride can produce lower fluorides of sulfur, some of which are toxic. Inhalation of Sulfur Hexafluoride after electrical discharge must be avoided.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to Sulfur Hexafluoride may cause the following health effects:

ACUTE: The most significant hazard associated with this gas is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, and, at high concentrations, unconsciousness or death may occur. The skin of a victim of over-exposure may have a blue color.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to this product.

TARGET ORGANS: Respiratory system.

3. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					OTHER
			ACGIH		OSHA			
			TLV ppm	STEL ppm	PEL 1000	STEL ppm	IDLH ppm	
Sulfur Hexafluoride	2551-62-4	> 99.8%	1000	NE	1000	NE	NE	NIOSH REL: 1000 ppm DFG MAK: 1000 ppm
Maximum Impurities		< 0.02%	None of the trace impurities in this product contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalents standards.					

This material is classified as hazardous under OSHA regulations in the United States and the WHMIS in Canada.

NE = Not Established

C = Ceiling Limit

See Section 16 for Definitions of Terms Used.

NOTE: all WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-2004 format.

4 FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus should be worn.

Remove victim(s) to fresh air, as quickly as possible. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Only trained personnel should administer supplemental oxygen.

SKIN EXPOSURE: If Sulfur Hexafluoride gas or liquid contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention. 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 liquid is splashed into eyes, or if irritation of the eye develops after exposure to liquid or gas, 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. Seek medical assistance immediately, preferably an ophthalmologist.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS: Non-flammable, inert gas. Use extinguishing media appropriate for surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Sulfur Hexafluoride does not burn; however, containers, when involved in fire, may rupture or burst in the heat of the fire. Products of thermal decomposition of this product includes toxic gases (i.e. sulfuryl and thionyl fluorides).

Explosion Sensitivity to Mechanical Impact: Not Sensitive.

Explosion Sensitivity to Static Discharge: This product will not explode if exposed to static electrical discharge. Sulfur Hexafluoride is not corrosive to most metals under normal conditions. This product may be partially decomposed if subjected to static discharge. Some of the breakdown products are corrosive and will be enhanced by the presence of moisture or at high temperatures. Sulfur Hexafluoride also decomposes slightly in the presence of certain metals at temperatures in excess of 400°F (204°C), this effect being most pronounced with silicon and carbon steels.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment.

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel.

Minimum Personal Protective Equipment should be: **Level B: Self-Contained Breathing Apparatus.** Locate and seal the source of the leaking gas. Allow the gas, which is lighter than air to dissipate. Monitor the surrounding area for oxygen levels. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus.

If leaking incidentally from the cylinder or its valve, contact your supplier.

7. HANDLING AND STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this product could occur without any significant warning symptoms, due to oxygen deficiency.

STORAGE AND HANDLING PRACTICES: 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. Use only storage containers and equipment (pipes, valves, fittings to relieve pressure, etc.) designed for the storage of Liquid Sulfur Hexafluoride.

Use a check valve or other protective device in the discharge line to prevent hazardous backflow. Never tamper with pressure relief valves and cylinders.

Keep the smallest amount necessary on-site at any one time. Full and empty cylinders should be segregated. Use a first-in, first-out inventory systems to prevent full containers from being stored for long periods of time.

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.

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 an electric circuit.

After Use: Close main cylinder valve. Valves should be closed tightly. Replace valve protection cap. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers designed for gas storage. Close valve after each use and when empty.

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

<u>THREADED:</u>	CGA 590
<u>PIN-INDEXED YOKE:</u>	Not Applicable.
<u>ULTRA HIGH INTEGRITY:</u>	Not Applicable.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Local exhaust ventilation is preferred, because it prevents gas dispersion into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of oxygen.

RESPIRATORY PROTECTION: Maintain exposure levels of Sulfur Hexafluoride below the levels listed in Section 2 (Composition and Information on Ingredients) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Sulfur Hexafluoride levels exceed exposure limits and if oxygen level is below 19.5% or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards.

EYE PROTECTION: Safety glasses.

HAND PROTECTION: Wear leather gloves or glove protection appropriate to the specific operation for which this product is used.

BODY PROTECTION: Use body protection appropriate for task. Safety shoes are recommended when handling cylinders.

9. PHYSICAL and CHEMICAL PROPERTIES

GAS DENSITY @ 20°C (68°F) and 1 atm: 0.385 lbs ft³ (6.17 kg/m³)

BOILING POINT @ 1 atm (Sublimation Point): -63.7°C (-82.7°F)

FREEZING/MELTING POINT (@ 325 psia): -50.8°C (-59.4°F)

SPECIFIC GRAVITY (air = 1) @ 20°C (68°F): 5.11

SOLUBILITY IN WATER vol/vol @ 25°C (77°F): 0.001

EVAPORATION RATE (nBuAc = 1): Not applicable.

ODOR THRESHOLD: Not applicable. Odorless.

VAPOR PRESSURE @ 21.1°C (70°F) psig: 298

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

APPEARANCE AND COLOR: This product is a colorless, odorless, liquefied gas.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no unusual warning properties associated with a release of this product. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

pH: Not applicable.

MOLECULAR WEIGHT: 146.05

EXPANSION RATIO: Not applicable.

SPECIFIC VOLUME (ft³/lb): 2.5

10. STABILITY and REACTIVITY

STABILITY: Normally stable, inert gas.

DECOMPOSITION PRODUCTS: Sulfur oxides and hydrogen fluoride.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Sulfur Hexafluoride is non-reactive with most chemicals. This product, however, can violently react with disilane. Sulfur Hexafluoride is only stable at elevated temperatures (> 400 °F) when contained in aluminum, stainless steel, copper, brass, or silver. Other metals can cause slow decomposition to sulfur-fluoride compounds. If this decomposition occurs in the presence of oxygen, thionyl fluoride compounds can be generated.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid exposing cylinders to extremely high temperatures, which could cause the cylinders to rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following data is for Sulfur Hexafluoride:

Standard human toxicity values are not available.

Male rats were exposed for periods of 16-24 hours to 20% oxygen and 80% Sulfur Hexafluoride at 1 atmosphere ambient pressure showed no changes.

SUSPECTED CANCER AGENT: Sulfur Hexafluoride is not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC, and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Not applicable.

SENSITIZATION OF PRODUCT: Sulfur Hexafluoride is not a sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Sulfur Hexafluoride on the human reproductive system.

Mutagenicity: Sulfur Hexafluoride is not expected to cause mutagenic effects in humans.

Embryotoxicity: Sulfur Hexafluoride is not expected to cause embryotoxic effects in humans.

Teratogenicity: Sulfur Hexafluoride is not expected to cause teratogenic effects in humans.

Reproductive Toxicity: Sulfur Hexafluoride is not expected to cause adverse reproductive effects in humans.

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

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by over-exposure to Sulfur Hexafluoride.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Sulfur Hexafluoride.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The gas will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments. No adverse effect is anticipated to occur to plant-life, except for frost produced in the presence of rapidly expanding gases.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

13. DISPOSAL CONSIDERATIONS

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.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Sulfur Hexafluoride, compressed
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1080
PACKING GROUP: Not applicable.
DOT LABEL(S) REQUIRED: Non-Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 126

MARINE POLLUTANT: Sulfur Hexafluoride is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles present serious safety hazards and should be discouraged.

NOTE: Shipment of compressed gas cylinders which have not been filled with the owners consent is a violation of Federal law (49 CFR, Part 173.301 (b)).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: Sulfur Hexafluoride is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act. This product is subject to the reporting requirements of Sections 311 and 312 of Title III of the Superfund Amendments and Reauthorization Act (40 CFR 370.21).

SARA THRESHOLD PLANNING QUANTITY: Not applicable.

TSCA INVENTORY STATUS: Sulfur Hexafluoride is listed on the TSCA Inventory.

CERCLA REPORTABLE QUANTITIES (RQ): Not applicable.

CALIFORNIA PROPOSITION 65: Sulfur Hexafluoride is not on the California Proposition 65 lists.

STATE REGULATORY INFORMATION: Sulfur Hexafluoride is covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Sulfur Hexafluoride.

California - Permissible Exposure Limits for Chemical Contaminants: Sulfur Hexafluoride.

Florida - Substance List: Sulfur Hexafluoride.

Illinois - Toxic Substance List: Sulfur Hexafluoride.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: Sulfur Hexafluoride.

Minnesota - List of Hazardous Substances: Sulfur Hexafluoride.

Missouri - Employer Information/Toxic Substance List: Sulfur Hexafluoride.

New Jersey - Right to Know Hazardous Substance List: Sulfur Hexafluoride.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.

Pennsylvania - Hazardous Substance List: No.

Rhode Island - Hazardous Substance List: Sulfur Hexafluoride.

Texas - Hazardous Substance List: Sulfur Hexafluoride.

West Virginia - Hazardous Substance List: Sulfur Hexafluoride.

Wisconsin - Toxic and Hazardous Substances: Sulfur Hexafluoride.

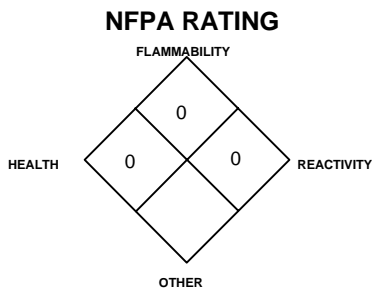
15. REGULATORY INFORMATION (Continued)

OTHER U.S. FEDERAL REGULATIONS:

- Sulfur Hexafluoride does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82).
- Sulfur Hexafluoride is not listed as a Regulated Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Accidental Release Prevention.
- Sulfur Hexafluoride is not subject to the reporting requirements of Section 112(r) of the Clean Air Act.
- Sulfur Hexafluoride is not listed in Appendix A as a highly hazardous chemical, per 29 CFR 1910.119: Process Safety Management of Highly Hazardous Chemicals.

OTHER CANADIAN REGULATIONS: Sulfur Hexafluoride is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations.

16. OTHER INFORMATION



HAZARDOUS MATERIAL INFORMATION SYSTEM		
HEALTH	(BLUE)	0
FLAMMABILITY	(RED)	0
REACTIVITY	(YELLOW)	0
PROTECTIVE EQUIPMENT	B	
EYES	RESPIRATORY	HANDS
BODY		
See Section 8		
For routine industrial applications		

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 Sulfur Hexafluoride can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 4221 Walney Road 5th floor, Chantilly, VA 20151-2923. Telephone: (703) 788-2700.

- P-1 *"Safe Handling of Compressed Gases in Containers"*
- P-14 *"Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmospheres"*
- SB-2 *"Oxygen Deficient Atmospheres"*
- AV-1 *"Safe Handling and Storage of Compressed Gases"*
- "Handbook of Compressed Gases"*

16. OTHER INFORMATION (Continued)

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
9163 Chesapeake Drive, San Diego, CA 92123-1002
619/565-0302

Fax on Demand: 1-800/231-1366



This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.