



FLUORINE

Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name	FLUORINE
Product Code(s)	G-34, 1011
UN-Number	UN1045
Recommended Use	Compressed gas.
Synonyms	Fluorine, Compressed
Supplier Address*	<p>Linde Gas North America LLC - Linde Merchant Production Inc. - Linde LLC 575 Mountain Ave. Murray Hill, NJ 07974 Phone: 908-464-8100 www.lindeus.com</p> <p>Linde Gas Puerto Rico, Inc. Las Palmas Village Road No. 869, Street No. 7 Catano, Puerto Rico 00962 Phone: 787-641-7445 www.pr.lindegas.com</p> <p>Linde Canada Limited 5860 Chedworth Way Mississauga, Ontario L5R 0A2 Phone: 905-501-1700 www.lindecanda.com</p>

* May include subsidiaries or affiliate companies/divisions.

For additional product information contact your local customer service.

Chemical Emergency Phone Number Chemtrec: 1-800-424-9300 for US/ 703-527-3887 outside US

2. HAZARDS IDENTIFICATION

DANGER!	Emergency Overview	
	Oxidizer Fatal if inhaled The product causes burns of eyes, skin and mucous membranes Water reactive Accelerates combustion and increases risk of fire Contents under pressure Keep at temperatures below 52°C / 125°F	
Appearance Pale yellow	Physical State Compressed gas.	Odor Choking effect

OSHA Regulatory Status	This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<u>Potential Health Effects</u>	
Principle Routes of Exposure	Eye contact. Skin contact. Inhalation.
Acute Toxicity	
Inhalation	Fatal if inhaled. Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Delayed pulmonary edema may occur.
Eyes	Corrosive to the eyes and may cause severe damage including blindness.
Skin	Causes burns. Hydrolyzes very rapidly yielding hydrofluoric acid. Toxic level exposure to dermal tissue causes hydrofluoric acid burns and skin lesions resulting in early necrosis and eventual scarring. Symptoms may be delayed.
Skin Absorption Hazard	No known hazard in contact with skin.
Ingestion	Not an expected route of exposure. Ingestion causes burns of the upper digestive and respiratory tract.
Chronic Effects	Extended low level systemic absorption of fluorides may cause fluorosis, an abnormal calcification patter of the skeletal system
Aggravated Medical Conditions	Skin disorders. Pre-existing eye disorders. Respiratory disorders.
Environmental Hazard	See Section 12 for additional Ecological Information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Volume %	Chemical Formula
Fluorine	7782-41-4	>99	F ₂

4. FIRST AID MEASURES

General Advice	Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.
Eye Contact	Immediate medical attention is required. In case of contact with substance, immediately flush eyes with running water for at least 30 minutes. Keep eye wide open while rinsing.
Skin Contact	Immediate medical attention is required. Wash off immediately with soap and plenty of water for at least 30 minutes while removing all contaminated clothing and shoes. Dermal burns may be treated with calcium gluconate gel or slurry in water or glycerine. This compound binds the active fluorides in an insoluble form and limits burn extension and pain.
Inhalation	PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF INHALATION OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious inhalation victims should be assisted to an uncontaminated area and inhale fresh air. If breathing is difficult, administer oxygen. Unconscious persons should be moved to an uncontaminated area and, as necessary, given artificial resuscitation and supplemental oxygen. Treatment should be symptomatic and supportive.

Ingestion	Not an expected route of exposure. Immediate medical attention is required. Do NOT induce vomiting. Drink plenty of water. Never give anything by mouth to an unconscious person. Call a physician or Poison Control Center immediately.
Notes to Physician	For dermal exposure, the use of 2.5-33% calcium gluconate or carbonate gel or slurry has been recommended. The gel is either placed into a surgical glove into which the affected extremity is then placed or applied directly on the burn. This compound binds with the active fluorides in an insoluble form and limits burn extension and pain. Calcium chloride should not be used. Delayed pulmonary edema may occur.
Protection of First-aiders	Use personal protective equipment. Avoid contact with skin, eyes and clothing.

5. FIRE-FIGHTING MEASURES

Flammable Properties	Oxidizer. May vigorously accelerate combustion.
Suitable Extinguishing Media	DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED. It may be safer to allow the fire to burn itself out. Use water spray to knock down vapors and cool fire-exposed containers.
Hazardous Combustion Products	Hydrogen fluoride. Oxygen difluoride
<u>Explosion Data</u>	
Sensitivity to Mechanical Impact	None
Sensitivity to Static Discharge	None
Specific Hazards Arising from the Chemical	This is a strong oxidizer and will react vigorously or explosively with many materials including fuels. Will ignite combustible materials (wood, paper, oil, debris, etc.). Continue to cool fire exposed cylinders until flames are extinguished. Cylinders may rupture under extreme heat. Damaged cylinders should be handled only by specialists.
Protective Equipment and Precautions for Firefighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Corrosive hazard. Wear protective gloves/clothing and eye/face protection. Do not get water inside containers. For massive fire, use unmanned hose holders or monitor nozzles.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Use personal protective equipment. Avoid contact with skin, eyes and clothing.
Environmental Precautions	Prevent spreading of vapors through sewers, ventilation systems and confined areas. Should not be released into the environment.
Methods for Containment	Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.
Methods for Cleaning Up	Return cylinder to Linde or an authorized distributor.

Other Information

Refer to protective measures listed in Sections 7 and 8.

7. HANDLING AND STORAGE

Handling

Most metals form a passive fluoride film with low pressure fluorine that protects the metals from further corrosion. The reaction with metals and fluorine is relatively slow at room temperature, but becomes vigorous and self-sustaining if the temperature is elevated. Monel® and nickel are preferred for high temperature applications. Teflon® is the preferred gasket material.

Keep equipment scrupulously dry. Many of the metal fluorides are water soluble so that the passive film corrosion protection may be destroyed if wetted with water. Process valves should be opened and closed with remote controlled extensions passing through a suitable barricade for additional protection. Double valving should be employed to facilitate the reduction in pressure from high pressure sources of fluorine.

Use only in ventilated areas. Never attempt to lift a cylinder by its valve protection cap. Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Use equipment rated for cylinder pressure. Use backflow preventive device in piping. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. "NO SMOKING" signs should be posted in storage and use areas.

Use an adjustable strap wrench to remove over-tight or rusted caps. Close valve after each use and when empty. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never attempt to refill a compressed gas cylinder without the owner's written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

Storage

Protect from physical damage. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Keep at temperatures below 52°C / 125°F. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers. Outside or detached storage is preferred.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Fluorine 7782-41-4	STEL: 2 ppm TWA: 1 ppm	TWA: 0.1 ppm TWA: 0.2 mg/m ³ (vacated) TWA: 0.1 ppm (vacated) TWA: 0.2 mg/m ³	IDLH: 25 ppm TWA: 0.1 ppm TWA: 0.2 mg/m ³

Immediately Dangerous to Life or Health.

Other Exposure Guidelines	Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).
Engineering Measures	Showers. Eyewash stations. Ventilation systems. Exhaust gas should be vented to a gas treatment system.
Ventilation	Use ventilation adequate to keep exposures below recommended exposure limits.
<u>Personal Protective Equipment</u>	
Eye/Face Protection	Tightly fitting safety goggles. Face-shield.
Skin and Body Protection	Appropriate protective and chemical resistant gloves, clothing and splash protection, or fully encapsulating vapor protective clothing to prevent exposure. For materials of construction consult protective clothing manufacturer's specifications. (Teflon® is generally effective for exposures longer than 4 hours).
Respiratory Protection	
General Use	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
Emergency Use	Use positive pressure air line respirator or self-contained breathing apparatus for exposure over exposure limits or emergency use. For exposures above IDLH, an additional escape bottle is required.
Hygiene Measures	Avoid contact with skin, eyes and clothing. Remove and wash contaminated clothing before re-use. Contaminated work clothing should not be allowed out of the workplace. When using, do not eat, drink or smoke. Keep away from food, drink and animal feeding stuffs. Provide regular cleaning of equipment, work area and clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Pale yellow.	Odor	Choking effect.
Odor Threshold	(unspecified): 0.097-0.19 ppm	Physical State	Compressed gas
Flash Point	No information available.	Autoignition Temperature	No information available.
Decomposition Temperature	No information available.	Boiling Point/Boiling Range	-188.1 °C / -306.6 °F
Freezing Point	-219.7 °C / -363.5 °F	Molecular Weight	38.00
Water Solubility	Reacts with water	Evaporation Rate	No information available
Vapor Pressure	Above critical temp.	Vapor Density	1.31 (air = 1)
Gas Density	@ 21.1°C (70°F): 0.106 lb./ft ³ (1.70 kg/m ³)	VOC Content (%)	Not applicable.
Specific Vol. @ 21.1°C & 1 atm	10.17 lb ³ /ft (0.635 m ³ /kg)	Critical Pressure	756.4 psia (5215 kPa abs)
Flammability Limits in Air			
Upper	Not applicable		
Lower	Not applicable		

10. STABILITY AND REACTIVITY

Stability	Strong oxidizer. Contact with other material may cause fire.
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Incompatible Products	Fluorine is the most powerful oxidizer known. It reacts with virtually all organic and inorganic substances, except some inert gases, perfluorinated hydrocarbons and some metals which have been "passivated". Combustible materials.
Conditions to Avoid	Reacts with water to form hydrogen fluoride and oxygen. Heat, flames and sparks.
Hazardous Decomposition Products	Hydrogen fluoride. Oxygen difluoride.
Hazardous Polymerization	Hazardous polymerization does not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

LD50 Oral:	No information available.
LD50 Dermal:	No information available.
LC50 Inhalation:	Per CGA P-20: LC50: 185 ppm/1 hr. (Rat)
Inhalation	Mice exposed to sublethal concentrations (LC50: 150 ppm/1 hr.) of fluorine experienced pulmonary irritation and delayed focal necrosis of the liver and kidney.
Repeated Dose Toxicity	No information available.

Chronic Toxicity

Chronic Toxicity	Extended low level systemic absorption of fluorides may cause fluorosis, an abnormal calcification patten of the skeletal system.
Carcinogenicity	Contains no ingredient listed as a carcinogen.
Irritation	No information available.
Sensitization	No information available.
Reproductive Toxicity	No information available.
Developmental Toxicity	No information available.
Synergistic Materials	None known.
Target Organ Effects	Eyes. Kidney. Liver. Respiratory system. Skin.

12. ECOLOGICAL INFORMATION

Ecotoxicity

The environmental impact of this product has not been fully investigated.

Ozone depletion potential; ODP; (R-11 = 1): Does not contain ozone depleting chemical (40 CFR Part 82).

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods	Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Linde for proper disposal.
Contaminated Packaging	Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Fluorine, compressed
Hazard Class	2.3
Subsidiary Class	5.1, 8
UN-Number	UN1045
Special Provisions	This material is toxic by inhalation in Hazard Zone A.
Description	UN1045,Fluorine, compressed,2.3,(5.1, 8)
Additional Description:	"Toxic-Inhalation Hazard Zone A". If net weight of product is greater than or equal to 10 lbs., the shipping description must also contain the letters "RQ".
Additional Marking Requirements:	"Inhalation Hazard". If net weight of product is greater than or equal to 10 lbs., the container must also be marked with the letters "RQ".
Emergency Response Guide Number	124

TDG

Proper Shipping Name	Fluorine, compressed
Hazard Class	2.3
Subsidiary Class	(5.1), (8)
UN-Number	UN1045
Description	UN1045,FLUORINE, COMPRESSED,2.3(5.1), (8)

MEX

Proper Shipping Name	Fluorine, compressed
Hazard Class	2.3
Subsidiary Class	5.1, 8
UN-Number	UN1045
Description	UN1045 Fluorine, compressed,2.3

IATA

UN-Number	UN1045
Proper Shipping Name	Fluorine, compressed
Hazard Class	2.3
Subsidiary Class	5.1, 8
ERG Code	2PX
Description	UN1045,Fluorine, compressed,2.3(5.1, 8)
Maximum Quantity for Passenger	Forbidden
Maximum Quantity for Cargo Only	Forbidden
Limited Quantity	No information available.

IMDG/IMO

Proper Shipping Name	Fluorine, compressed
Hazard Class	2.3

Subsidiary Class 5.1, 8
 UN-Number UN1045
 EmS No. F-C, S-W
 Description UN1045, Fluorine, compressed,2.3(5.1, 8)

ADR

Proper Shipping Name Fluorine, compressed
 Hazard Class 2.3
 UN-Number UN1045
 Classification Code 1TOC
 Description UN1045 Fluorine, compressed,2.3,
 ADR/RID-Labels 5.1, 8

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL	Complies
EINECS/ELINCS	Complies

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
 DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
 EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

U.S. Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372:

Chemical Name	CAS-No	SARA 313 - Threshold Values %
Fluorine	7782-41-4	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	Yes
Reactive Hazard	Yes

Clean Water Act

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Risk and Process Safety Management Programs

This material, as supplied, contains one or more regulated substances with specified thresholds under 40 CFR Part 68 or regulated as a highly hazardous chemical pursuant to the 29 CFR Part 1910.110 with specified thresholds:

Chemical Name	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances	U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
Fluorine	1000 lbs		1000 lb

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)

This product does not contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act Amendments of 1990.

CERCLA/SARA

This material, as supplied, contains one or more substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355):

Chemical Name	Hazardous Substances RQs	Extremely Hazardous Substances RQs	TPQ
Fluorine	10 lb	10 lb	500 lb TPQ

U.S. State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical Name	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Fluorine	X	X	X	X	X

International Regulations

Chemical Name	Carcinogen Status	Exposure Limits
Fluorine		Mexico: TWA 1 ppm Mexico: TWA 2 mg/m ³ Mexico: STEL 2 ppm Mexico: STEL 4 mg/m ³

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

- A Compressed gases
- E Corrosive material
- D1A Very toxic materials
- F Dangerously reactive material



Chemical Name	NPRI
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Fluorine	X
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Legend

NPRI - National Pollutant Release Inventory

Prepared By Product Stewardship
 23 British American Blvd.
 Latham, NY 12110
 1-800-572-6501

Issuing Date 02-Apr-2010

Revision Date 20-Sep-2013

Revision Number 3

Revision Note (M)SDS sections updated. 15.

<u>NFPA</u>	Health Hazard 4	Flammability 0	Stability 4	Physical and Chemical Hazards W2 OX Personal Protection -
<u>HMIS</u>	Health Hazard 3	Flammability 0	Physical Hazard 3	

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

General Disclaimer

For terms and conditions, including limitation of liability, please refer to the purchase agreement in effect between Linde LLC, Linde Merchant Production, Inc. or Linde Gas North America LLC (or any of their affiliates and subsidiaries) and the purchaser.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

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End of Safety Data Sheet