HYDROGEN FLUORIDE
Safety Data Sheet

1. IDENTIFICATION

Product identifier
Product Name HYDROGEN FLUORIDE

Other means of identification
Safety data sheet number LIND-P070
UN / ID no. UN1052
Synonyms Hydrofluoric acid, anhydrous

Recommended use of the chemical and restrictions on use
Recommended Use Industrial and professional use.
Uses advised against Consumer use

Details of the supplier of the safety data sheet
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

Linde Gas Puerto Rico, Inc.
Road 869, Km 1.8
Barrio Palmas, Catano, PR 00962
Phone: 787-641-7445
www.pr.lindegas.com

Linde Canada Limited
5860 Chedworth Way
Mississauga, Ontario L5R 0A2
Phone: 905-501-1700
www.lindecanada.com

* May include subsidiaries or affiliate companies / divisions.

For additional product information contact your local customer service.
Emergency telephone number
Company Phone Number 800-232-4726 (Linde National Operations Center, US)
905-501-0802 (Canada)
CHEMTREC: 1-800-424-9300 (North America) +1-703-527-3887 (International)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Acute toxicity - Dermal	Category 1
Acute toxicity - Inhalation (Vapors)	Category 3
Skin corrosion / irritation	Category 1 Sub-category A
Serious eye damage / eye irritation	Category 1

Label elements

Signal word Danger

Hazard Statements
Fatal in contact with skin
Toxic if inhaled
Causes severe skin burns and eye damage
Corrosive to the respiratory tract
Symptoms may be delayed

Precautionary Statements - Prevention
Do not handle until all safety precautions have been read and understood
Avoid breathing vapor
Do not get in eyes, on skin, or on clothing
Wash hands thoroughly after handling
Do not eat, drink or smoke when using this product
Use and store only outdoors or in a well ventilated place
Wear protective gloves, protective clothing, eye protection, and / or face protection
Use a backflow preventive device in piping
Use only with equipment of compatible materials of construction and rated for cylinder pressure
Do not open valve until connected to equipment prepared for use
Close valve after each use and when empty

Precautionary Statements - Response
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor / physician.
IF ON SKIN (or hair): Remove / Take off immediately all contaminated clothing. Rinse skin with water / shower. Wash contaminated clothing before reuse. Immediately call a POISON CENTER or doctor / physician.
SPECIFIC TREATMENT:. Apply calcium gluconate cream to affected areas on skin.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor / physician

Precautionary Statements - Storage
Store locked up
Protect from sunlight when ambient temperature exceeds 52°C / 125°F

Precautionary Statements - Disposal
Dispose of contents / containers in accordance with container supplier / owner instructions

Hazards not otherwise classified (HNOC)
Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Volume %	Chemical Formula
Hydrogen fluoride	7664-39-3	100	HF

4. FIRST AID MEASURES

Description of first aid measures

General advice — Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Inhalation — Remove to fresh air and keep comfortable for breathing. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration. Get medical attention immediately.

Skin contact — Immediately flush skin with plenty of water for at least 30 minutes. Remove contaminated clothing and shoes. Immediate medical attention is required. 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.

Eye contact — Immediately flush eyes with running water for at least 30 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Keep eye wide open while rinsing. Do not rub affected area. Immediate medical attention is required.

Ingestion — Not an expected route of exposure.

Self-protection of the first aider — RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Use personal protective equipment. Avoid contact with skin, eyes and clothing. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Most important symptoms and effects, both acute and delayed

Symptoms — 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. May cause burns of eyes, skin and mucous membranes. Symptoms may be delayed.

Indication of any immediate medical attention and special treatment needed

Note to physicians — 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.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Specific extinguishing methods
Continue to cool fire exposed cylinders until flames are extinguished. Damaged cylinders should be handled only by specialists. Fire residues

and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

Specific hazards arising from the chemical
Will produce corrosive hydrofluoric acid in contact with water. Not combustible but evolves heat on contact with water. Reactions of hydrogen fluoride with metal piping and vessels generates hydrogen creating the potential for explosion. Cylinders may rupture under extreme heat. The product causes burns of eyes, skin and mucous membranes. Thermal decomposition can lead to release of irritating and toxic gases and vapors. Do not allow runoff from fire-fighting to enter drains or water courses. Runoff may pollute waterways.

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 chemically protective gloves / clothing and eye / face protection.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions	Evacuate personnel to safe areas. Keep people away from and upwind of spill / leak. Ensure adequate ventilation, especially in confined areas. Monitor concentration of released product. Use personal protection recommended in Section 8. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.
Other Information	Gas / vapor is heavier than air. Prevent from entering sewers, basements and workpits, or any place where accumulation may be dangerous.

Environmental precautions

Environmental precautions	Prevent spreading of vapors through sewers, ventilation systems and confined areas. Do not allow into any sewer, on the ground or into any body of water. Prevent product from entering drains. See Section 12 for additional ecological information.

Methods and material for containment and cleaning up

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.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling	Most metals corrode rapidly with wet hydrogen fluoride. Copper-nickel alloys and copper-tin alloys as well as stainless steel and nickel-chromium alloys offer best resistance to HF corrosion. Kel-F® and Teflon® are best for gasketing materials. Do not use Buna S®, Buna N®, or Neoprene. USE ONLY RECOMMENDED FITTINGS FOR HYDROGEN FLUORIDE SYSTEM TO AVOID FORMATION OF HYDROGEN GAS. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. 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. Never attempt to lift a cylinder by its valve protection cap. Never insert an object (e.g. wrench, screwdriver, pry bar,etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Use only with adequate ventilation. Use a backflow preventive device in piping. Use only with equipment rated for cylinder pressure. Close valve after each use and when empty. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Ensure the complete gas system has been checked for leaks before use.

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.

Only experienced and properly instructed persons should handle gases under pressure. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

Conditions for safe storage, including any incompatibilities

Storage Conditions: 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. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Full and empty cylinders should be segregrated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Stored containers should be periodically checked for general condition and leakage.

Incompatible materials: Water. Combustible materials. Organic material. Alkalis.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines .

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Hydrogen fluoride 7664-39-3	TWA: 0.5 ppm F TWA: 2.5 mg / m³ F S* Ceiling: 2 ppm F	TWA: 3 ppm F TWA: 2.5 mg / m³ F TWA: 2.5 mg / m³ dust (vacated) TWA: 3 ppm F (vacated) STEL: 6 ppm F	IDLH: 30 ppm Ceiling: 6 ppm 15 min Ceiling: 5 mg / m³ 15 min TWA: 3 ppm TWA: 2.5 mg / m³

ACGIH TLV: American Conference of Governmental Industrial Hygienists - Threshold Limit Value. OSHA PEL: Occupational Safety and Health Administration - Permissible Exposure Limits. NIOSH IDLH: Immediately Dangerous to Life or Health

Other Information: Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Appropriate engineering controls

Engineering Controls: Showers. Eyewash stations. Ventilation systems. Exhaust gas should be vented to a gas treatment system. Consider installation of leak detection systems in areas of use and storage. Systems under pressure should be regularly checked for leakages.

Individual protection measures, such as personal protective equipment

Eye / face protection: Tightly fitting safety goggles. Face protection 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. (Responder® and Tychem 10,000® are effective for exposures > 8 hours). Work gloves and safety shoes are recommended when handling cylinders.

Respiratory protection: 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.

General Hygiene Considerations: Handle in accordance with good industrial hygiene and safety practice. Do not eat, drink or smoke when using this product. Do not get in eyes, on skin, or on clothing. Remove and wash contaminated clothing before re-use. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Liquid Gas
Appearance	Colorless.
Odor	Pungent.
Odor threshold	0.042 ppm (EPA)
pH	If dissolved in water, will affect pH value
Melting point	-83.4 °C / -118.1 °F
Evaporation rate	Not applicable
Lower flammability limit:	Not applicable
Upper flammability limit:	Not applicable
Flash point	Not applicable.
Autoignition temperature	No data available
Decomposition temperature	No data available
Water solubility	Very soluble
Partition coefficient	No data available
Kinematic viscosity	Not applicable

Chemical Name	Molecular weight	Boiling point	Vapor Pressure	Vapor density (air =1)	Gas Density kg / m^3@20°C	Critical Temperature
Hydrogen fluoride	20.00	19.52 °C	107.1 kPa @ 21.1 °C	1.86	3.2	188 °C

10. STABILITY AND REACTIVITY

Reactivity
Not reactive under normal conditions

Chemical stability
Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	None.

Possibility of Hazardous Reactions
Reacts to form hydrogen gas on contact with most metals. Etches glass. Liquid hydrogen fluoride reacts incandescently with oxides.

Conditions to avoid
Protect from moisture. Contact with water or moist air liberates irritating gas.

Incompatible materials
Water. Combustible materials. Organic material. Alkalis.

Hazardous Decomposition Products
Fluoride compounds. Thermal decomposition can lead to release of irritating and toxic gases and vapors.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	Inhalation of 300 ppm for 2 hours or more cause death in guinea pigs and rabbits. In animals, repeated inhalation of 17 ppm Hydrogen fluoride has resulted in damage to the lungs, liver and kidneys. A similar study at 8.6 ppm failed to cause significant pathological changes in these tissues. Corrosive to respiratory system.

Skin contact	Solutions can cause severe and painful burns. Skin contact with dilute solutions has resulted in burns several hours following exposure. These dilute solutions produced little or no irritation at the time of exposure. Corrosive. Causes severe irritation and or burns.
Eye contact	Solutions can cause severe and painful burns. Corrosive to the eyes and may cause severe damage including blindness.
Ingestion	Not an expected route of exposure.

Information on toxicological effects

Symptoms	May be 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. Symptoms may be delayed.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion / irritation	Category 1A.
Serious eye damage / eye irritation	Category 1.
Irritation	Causes severe irritation and or burns.
Corrosivity	Corrosive to living tissue.
Sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	This product does not contain any carcinogens or potential carcinogens listed by OSHA, IARC or NTP.
Reproductive toxicity	Not classified.
STOT - single exposure	Not classified.
STOT - repeated exposure	Not classified.
Chronic toxicity	Extended low level systemic absorption of fluorides may cause fluorosis, an abnormal calcification pattern of the skeletal system. Chronic exposure to corrosive fumes / gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen.
Target Organ Effects	Skin, Respiratory system, Eyes.
Aspiration hazard	Not applicable.

Numerical measures of toxicity

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50	Inhalation LC50 (CGA P-20)
Hydrogen fluoride 7664-39-3	-	-	= 0.79 mg / L (Rat) 1 h	1276 ppm (Rat) 1hr

Product Information

Oral LD50	No information available
Dermal LD50	No information available
Inhalation LC50	No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Harmful to aquatic organisms. May cause pH changes in in aqueous ecological systems.

Chemical Name	Algae / aquatic plants	Fish	Crustacea
Hydrogen fluoride 7664-39-3	-	660: 48 h Leuciscus idus mg / L LC50	270: 48 h Daphnia species mg / L EC50

Persistence and degradability

Not applicable.

Bioaccumulation

No information available.

Chemical Name	Partition coefficient
Hydrogen fluoride 7664-39-3	-1.4

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes — 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.

14. TRANSPORT INFORMATION

DOT

UN / ID no.	UN1052
Proper shipping name	Hydrogen fluoride, anhydrous
Hazard Class	8
Subsidiary class	6.1
Packing Group	I
Special Provisions	3, B7, B46, B77, N86, T10, TP2
Description	UN1052, Hydrogen fluoride, anhydrous, 8 (6.1), I
Additional Description:	If net weight of product is greater than or equal to 100 lbs., the shipping description must also contain the letters "RQ".
Additional Marking Requirements:	If net weight of product is greater than or equal to 100 lbs., the container must also be marked with the letters "RQ".
Emergency Response Guide Number	125

TDG

UN / ID no.	UN1052
Proper shipping name	Hydrogen fluoride, anhydrous
Hazard Class	8
Subsidiary class	6.1
Packing Group	I
Description	UN1052, Hydrogen fluoride, anhydrous, 8 (6.1), I

MEX

UN / ID no.	UN1052
Proper shipping name	Hydrogen fluoride, anhydrous
Hazard Class	8
Subsidiary class	6.1
Packing Group	I
Description	UN1052, Hydrogen fluoride, anhydrous, 8 (6.1), I

IATA — Forbidden

IMDG

UN / ID no.	UN1052
Proper shipping name	Hydrogen fluoride, anhydrous
Hazard Class	8
Subsidiary hazard class	6.1
Packing Group	I
EmS-No.	F-C, S-U
Description	UN1052, Hydrogen fluoride, anhydrous, 8 (6.1), I

ADR

UN / ID no.	UN1052
Proper shipping name	Hydrogen fluoride, anhydrous
Hazard Class	8
Packing Group	I
Classification code	CT1
Tunnel restriction code	(C / D)
Description	UN1052, Hydrogen fluoride, anhydrous, 8 (6.1), I, (C / D)
Labels	6.1

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL / NDSL	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 Chemical Substances / European List of Notified Chemical Substances

US 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	SARA 313 - Threshold Values %
Hydrogen fluoride - 7664-39-3	1.0

SARA 311 / 312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden release of pressure hazard	Yes
Reactive Hazard	Yes

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302).

Chemical Name	Hazardous Substances RQs	CERCLA / SARA RQ	Reportable Quantity (RQ)
Hydrogen fluoride 7664-39-3	100 lb	100 lb	RQ 100 lb final RQ RQ 45.4 kg final RQ

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

This product contains the following substances which are listed hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act:

Chemical Name	CAS No.	Hazardous air pollutants (HAPs) content	VOC Chemicals	Class 1	Class 2
Hydrogen fluoride	7664-39-3				

CWA (Clean Water Act)

This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Hydrogen fluoride	100 lb	-	-	X

7664-39-3				

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
Hydrogen fluoride	1000 lb		1000 lb

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Hydrogen fluoride 7664-39-3	X	X	X

Chemical Name	Carcinogenicity	Exposure Limits
Hydrogen fluoride		Mexico: Ceiling 3 ppm Mexico: Ceiling 2.5 mg / m^3 Mexico: TWA 2.5 mg / m^3

Chemical Name	NPRI
Hydrogen fluoride	X

Legend

Canada NPRI - National Pollutant Release Inventory

16. OTHER INFORMATION

NFPA Health hazards 3 Flammability 0 Instability 1 Physical and Chemical Properties W1**

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.

Issue Date	20-Mar-2015
Revision Date	14-May-2015
Revision Note	Not applicable

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.

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End of Safety Data Sheet