

**Purpose:**

The purpose of this safety instruction is to inform workers about the hazards associated with using hydrogen fluoride gas/hydrofluoric acid (HF) and to establish safe practice guidelines. Laboratories that use HF must develop laboratory specific Standard Operating Procedures (SOPs) that describe training measures and use and include these within their laboratory's Chemical Hygiene Plan.

**PI Responsibilities:**

- Develop laboratory specific standard operating procedure.
- HF handling and hazard training for all laboratory personnel in which HF is being used.
- Develop an emergency response plan.
- Develop a spill response plan.

**Chemical Properties:**

HF is a neutral lipid-soluble molecule that penetrates tissue more rapidly than typical mineral acids. HF is colorless, and its solutions are clear, colorless liquids. When exposed to air, concentrated solutions produce pungent fumes which are especially dangerous. Dilute concentrations of HF in water (e.g., less than 40% HF) do not produce significant vapor concentrations.

**Hydrofluoric Acid- CAS# 7664-39-3;** also known as Hydrogen Fluoride; Hydrofluoride; Fluohydric acid; Fluoric acid; Hydrofluoric acid solution; HFA; HF; Etching acid; Fluorohydric acid; Hydrogen fluoride in aqueous solution.

**Physical Description:** Colorless gas or fuming liquid (below 67°F) with a strong, irritating odor.

**Danger! May be fatal if inhaled, absorbed through the skin or swallowed. Both liquid and vapor can cause severe burns to all parts of the body.**

**WARNING: Hydrofluoric acid is a contact poison. Contact may not be noticed until long after serious damage has been done. HF can cause serious burns to the skin with significant complications due to the fluoride toxicity. Deaths have been reported from concentrated acid burns involving as little as 2.5% Body Surface Area (BSA), an area roughly the size of your hand is sufficient to cause death.**

- HF is a calcium seeker. A person can't sense when it comes in contact with the skin. But, it dissolves the calcium in the bone. HF burns are not evident until a day later. If not stored, handled and disposed of properly, HF can pose a serious threat to the health and safety of laboratory personnel, emergency responders and waste handlers. Hence, it is important to thoroughly understand the properties of HF and follow all safety protocols to properly store and handle HF.
- Specialized medical treatment is required for any exposure to HF. Absorbed fluoride can cause metabolic imbalances with irregular heartbeat, nausea, dizziness, vomiting and seizures. Long-term exposure may cause bone and joint changes. Will attack glass and any silicon-containing material. Corrosive to metal. Before using this product, make sure that personal protective equipment and engineering controls are used and operating, and also that first aid treatments and procedures are available and understood.
- **Target Organs:** Lungs, teeth, eyes, skin, bone, mucous membranes

**Potential Health Effects:**

**Eye:** Contact with liquid or vapor causes severe burns and possible irreversible eye damage. Solutions as dilute as 2% or lower may cause burns.

**Skin:** May be fatal if absorbed through the skin. Causes severe burns with delayed tissue destruction. Substance is rapidly absorbed through the skin. Penetration may continue for several days. Causes severe tissue necrosis and bone destruction. Both liquid and vapor can cause severe burns, which may not be immediately painful or visible. Solutions as dilute as 2% or lower may cause burns. Systemic fluoride toxicity from exposure to hydrofluoric acid may result in severe hypocalcemia, hypomagnesemia, hyperkalemia, metabolic acidosis, cardiac dysrhythmias, and death. Burns caused by weak hydrofluoric acid may go unnoticed for several hours. Therefore, first aid procedures must be followed if any contact is suspected.

**Ingestion:** Causes severe digestive tract burns with abdominal pain, vomiting, and possible death. Human fatalities have been

reported from acute poisoning. Systemic fluoride toxicity from exposure to hydrofluoric acid may result in severe hypocalcemia (depletion of calcium in the blood), hypomagnesemia, hyperkalemia, metabolic acidosis, cardiac dysrhythmias, and death.

**Inhalation:** May be fatal if inhaled. May cause severe irritation of the upper respiratory tract with pain, burns, and inflammation. May cause pulmonary edema and severe respiratory disturbances. Depletes calcium levels in the body which can lead to hypocalcemia and death. Concentrations of hydrofluoric acid above 40% fume in air.

**Chronic:** Chronic inhalation and ingestion may cause chronic fluoride poisoning (fluorosis) characterized by weight loss, weakness, anemia, brittle bones, and stiff joints. Repeated inhalation may cause chronic bronchitis. Chronic exposure to fluoride compounds may cause systemic toxicity. Skeletal effects may include bone brittleness, joint stiffness, teeth discoloration, tendon calcification, and osteosclerosis. Chronic ingestion or inhalation may cause weight loss, malaise, anemia, leukopenia (reduction in the number of white blood cells in the blood), discoloration of the teeth and osteosclerosis (the hardening or abnormal density of bone). Repeated inhalation may cause osteofluorosis and permanent respiratory damage.

**Exposure Limits:**

**DOSH:** CEIL: 3 ppm

**OSHA:** TWA: 3 ppm

**NIOSH:** TWA: 3 ppm; CEIL: 6 ppm [15 minute]

**ACGIH:** TWA: 0.5 ppm; CEIL: 2 ppm

**\*Always refer to the Safety Data Sheet for the most detailed information\*** OSU SDS Database: <http://oregonstate.edu/ehs/sds>

**Safety Practices:**

- **Chemical Fume Hood:** The safest work space for working with HF is in a functioning fume hood. Before using the hood, check to see if it has been certified and is working properly. Perform all HF procedures on an absorbent pad (or Pink Pig Pads) and in a secondary containment.
- **Gloves:** HF readily penetrates skin and can become trapped under fingernails. Heavy neoprene or nitrile rubber gloves are best for working with HF. Increased thickness of gloves can decrease dexterity. Instead of wearing heavy material gloves workers can wear 2 or more pairs of nitrile gloves (8 mil) which will provide increased protection while maintaining dexterity. OSU Glove Use Guide: <http://oregonstate.edu/ehs/glove>
- **Body Protection:** When working with HF wear the proper clothing and personal protective equipment that provides protection in the event of a spill. Long pants, long sleeves, and closed-toe shoes are to be worn in all laboratory settings. Always wear a lab coat that is chemical resistant (Blue Lab Coat) to protect your from spills and splashes.
- **Eye Protection:** Goggles, along with a face shield, should be worn when handling HF.
- **Team Work:** Never work alone when using HF. A trained buddy or user must be present in the laboratory. No one is to work with HF before 8:00 a.m. or after 5:00 p.m. or on weekends.
- **PPE Removal:** Once finished handling HF take off gloves without making skin contact then thoroughly wash hands with soap and water. Protective clothing should not come in contact with bare skin when removing.
- **First-aid for skin contact:** When working pay close attention to the task at hand and do not allow yourself to become distracted. Contact with dilute HF solutions may not produce immediate pain, but may result in severe burns without immediate treatment. All labs should have calcium gluconate readily available; calcium gluconate binds to HF and prevents it from penetrating deeper into tissue. No work with HF can be done with an expired tube of calcium gluconate gel.
- **Training:** Employees who handle HF must read the Safety Data Sheet (SDS) and receive training on the hazards of HF, know what to do in the event of a spill or an exposure incident from their respective departments. Special training, HF Acid Safety is also required by EH&S.
- **Storage:** HF must be stored in a cool, dry place away from incompatible materials. Avoid contact with glass, concrete, metals, water, other acids, oxidizers, reducers, alkalis, combustibles, organics and ceramics. HF waste shall be placed in a chemically compatible container (i.e. polyethylene or Teflon) with a sealed lid and clearly labeled. Glass, metal, and ceramic containers are not compatible with HF. Always place HF on a low protected shelf other location where it will not be accident spilled or knocked over.

OSU Safety Instruction for PPE: <http://oregonstate.edu/ehs/sd0086>

OSU Chemical Storage guidelines: [http://oregonstate.edu/ehs/sites/default/files/pdf/si/chemical\\_storage\\_guidelines\\_si.pdf](http://oregonstate.edu/ehs/sites/default/files/pdf/si/chemical_storage_guidelines_si.pdf)

OSU Chemical Storage guidelines: [http://oregonstate.edu/ehs/sites/default/files/pdf/si/chemical\\_storage\\_guidelines\\_si.pdf](http://oregonstate.edu/ehs/sites/default/files/pdf/si/chemical_storage_guidelines_si.pdf)

**Spill Management:**

**All HF spills of must be reported to EH&S at 541-737-2273 to ensure contamination has been removed.**

All areas where HF is used must have a proper spill control kit. Small spills inside the fume hood can be neutralized by covering the acid with spill control pads. In the case of a large spill or a spill outside of a fume hood must evacuate all persons in the area and close all doors. Any type of accidental release of HF must be reported to laboratory personnel in the immediately vicinity.



In the event of a large HF spill (more than 50 ml) or a spill outside the fume hood, contact EHS immediately at 541-737-2273 or via Public Safety (541-737-7000). Do not attempt to clean up the spill yourself.

If small amounts (50 ml or less) of HF or HF solution spill inside the fume hood should, prevent any liquid from entering the sewer. Apply absorbent pads, using appropriate PPE, carefully scoop wetted absorbent material into a container to be manifested as hazardous waste.

If there is a fire or serious injury associated with a spill, call 911 immediately for assistance.

**SMALL HF spills (less than 50 ml) inside the fume hood:**

1. Assess the magnitude of the spill and the associated hazards (broken glass, toxic fumes, risk of fire, etc.).
2. If the hazards can be safely mitigated with available personal protective equipment (PPE), do so. This includes informing co-workers of the spill, removing ignition sources, and moving equipment that may be damaged by the spilled chemicals. (Note: contact EHS immediately at 541-737-2273 or via Public Safety (541-737-7000).
3. Once all hazards have been assessed, put on appropriate PPE (respiratory protection, goggles, body protection, gloves, impervious shoes/boots, etc.).
4. Apply the Pig Pads to the spill and give the pads time to absorb the chemical.
5. Use gloves and cardboard to move the used Pig Pads to a garbage bag.
6. Seal the garbage bag with a zip tie and label the bag with a Hazardous Waste Label.
7. Place the garbage bag in secondary containment (plastic tote/bin) labeled "Hazardous Waste." Place the box in a location in the laboratory where EH&S personnel will easily find it.
8. Request a Hazardous Waste Pickup (<http://oregonstate.edu/ehs/waste>).
9. Replenish you spill kit's contents immediately.

**LARGE HF spills (more than 50 ml) or any amount outside of the fume hood:**

1. Contact EHS immediately at 541-737-2273 or via Public Safety (541-737-7000) and tell them to contact the on-call EH&S personnel to respond to the HF spill.
2. Provide the following information:
  - Your name and contact phone number
  - Location of the spill (Building and room number)
  - Approximate volume of spilled liquid
  - Name of chemical
3. Do not attempt to clean up large and/or hazardous chemical spills.
4. Notify all other workers who could be affected by the spill and vacate the laboratory/floor/building, particularly if the chemical produces hazardous fumes or poses other potential health hazards.
5. Wait at the building entrance for EH&S personnel.
6. Serve as a point of contact and provide information about the spill, as requested by EH&S personnel.

**Emergency: (HF Exposure)**

- Emergency Procedure in the event of an exposure: Must be included in laboratory's Chemical Hygiene Plan

