



Standard Operating Procedure

Hydrofluoric Acid

Researchers should not use Hydrofluoric Acid until they have read and fully understood these safe operating procedures. However, reading these procedures does not substitute for hands-on training. New users of Hydrofluoric Acid must work under the close supervision of an experienced user.

BEFORE working with Hydrofluoric Acid, read the relevant Material Safety Data Sheets (MSDS)/ Safety Data Sheets (SDS) and understand the hazards. The safety sheet must be reviewed before using an unfamiliar chemical and periodically as a reminder. Personnel should also attend Hydrofluoric Acid training offered by Chemistry and Chemical Biology (CCB).

1.	This standard operating procedure (SOP) is for a
	<input type="checkbox"/> Specific laboratory procedure or experiment Examples: synthesis of chemiluminescent esters, folate functionalization of polymeric micelles <input type="checkbox"/> Generic laboratory procedure that covers several chemicals Examples: distillation, chromatography <input checked="" type="checkbox"/> Generic use of specific chemical or class of chemicals with similar hazards Examples: organic azides, mineral acids
2.	Chemical Description
	<p>Hydrofluoric acid is the inorganic compound with the formula HF (CAS Number: 7664-39-3). Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties, which make it especially hazardous to handle. Both Anhydrous Hydrofluoric acid and aqueous solutions are clear, colorless, and highly corrosive liquids. HF's unique properties, including systemic toxicity, make it significantly more hazardous than many other acids. All forms, including the solution or the vapor can cause severe burns to tissue and cause serious systemic effects. HF is a calcium seeking compound that can readily through skin.</p> <p><u>If exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.</u></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>

3.	<p>Risk assessment</p>
	<p>The primary hazard of HF is as a Health Hazard, it can readily absorb through the skin and signs or symptoms are dependent on the concentration. HF can destroy and decalcify soft tissue and bone, concentrations above 50% will burn immediately. One of HF's insidious properties is that concentrations lower than 20% may not produce immediate pain or burning. It is this delayed awareness of exposure that poses the most serious risk of HF. Exposure of the eyes of HF may result in blindness or permanent eye damage. Inhalation of HF vapor can seriously damage the lungs, and may cause fatal pulmonary edema (lungs flooding with fluid). Again, the increased risk being that signs and symptoms may not be apparent for hours after the exposure. Chronic (long term exposure) of low concentrations to HF may cause fluorosis; syndrome characterized by weight loss, bone embrittlement, anemia, and general ill health.</p>
4.	<p>Symptoms of Hydrofluoric Acid Exposure</p>
	<p>Hydrofluoric acid is extremely corrosive. It is harmful if inhaled, ingested, or absorbed through the skin. General symptoms include: burns to the mouth and throat causing severe pain, drooling, breathing difficulty from throat and mouth swelling and burning, abdominal pain, vomiting blood, chest pain, collapse (from low blood pressure or shock), and irregular heartbeat.</p> <ol style="list-style-type: none"> 1. <u>Eye Contact</u>: HF can cause severe eye burns with destruction or opacification of the cornea. Blindness may result from severe or untreated exposures. 2. <u>Inhalation</u>: irritation to the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath, bronchitis rhinitis and pulmonary edema. Acute symptoms of inhalation may include coughing, choking, chest tightness, chills, fever and cyanosis (blue lips and skin). HF fumes may cause swelling in the respiratory tract up to 24 hours after exposure. All individuals suspected of having inhaled HF should seek medical attention and observation for pulmonary effects. This includes any individuals with HF exposure to the head, chest or neck areas. If there is no initial upper respiratory irritation, significant inhalation exposure can generally be ruled out. 3. <u>Ingestion</u>: Hydrofluoric acid Ingestion may cause permanent damage to the digestive tract. If HF is ingested, severe burns to the mouth, esophagus and stomach may occur. Ingestion of even small amounts of dilute HF has resulted in death. <ol style="list-style-type: none"> a. If vomiting occurs, keep head lower than hips to prevent aspiration. b. Give large amounts of water or milk or milk of magnesia. c. Note: Never make an unconscious person vomit or drink fluids. If person is unconscious, turn head to side. 4. <u>Skin Contact</u>: Strong HF acid concentrations (over 50%) and anhydrous HF in particular, cause immediate, severe, burning pain and a whitish discoloration of the skin that usually proceeds to blister formation. The usual initial signs of a dilute solution HF burn are redness, swelling and blistering, accompanied by severe throbbing pain.

5.	Safety equipment
5.a.	<u>Engineering Controls:</u> HF in concentrations above 5% must be used in a chemical fume hood; when working with stock solutions and making formulations and dilutions. Even when working with small amounts of dilute Hydrofluoric Acid, the best practice is to work in a fume hood because of the splash protection the sash provides and the ability of the hood to contain emissions especially in the event of a spill. HF as a compressed gas must be contained within a ventilated cabinet (NOTE: HF gas at any percentage is considered Highly Hazardous).
5.b.	<u>Administrative Controls:</u> Individual who use HF must complete the CCB training. In addition, they shall review and sign off on this SOP. If able, use a shield or at a minimum keep the fume hood sash as low as possible to protect from splashes. When feasible, minimize the concentration of HF that is to be used. Never work alone when using Hydrofluoric acid. Procedures requiring the use of Hydrofluoric acid should have written safety SOPs associated with them. Signs should be posted in area of work and on lab door.
5.c.	<p>Personal Protection Equipment: All PPE should be inspected for wear, cracks or tears</p> <ol style="list-style-type: none"> 1. <u>Eye/Face Protection:</u> Chemical splash goggles that meet the ANSI Z.87.1 1989 standard must be worn whenever handling Hydrofluoric acid. <ol style="list-style-type: none"> a. Ordinary prescription glasses will NOT provide adequate protection unless they also meet this standard. b. Safety glasses even with side shields are not adequate protection for this material. c. Fume hood sash shall be properly positioned to provide splash, spray and mist protection. d. A face shield (in addition to goggles) may also be necessary. Consider that small facial burns caused by splatter may not be life threatening but can result in permanent disfiguration. 2. <u>Skin Protection:</u> Lab coat, long sleeves, closed toe shoes, long pants at a minimum. <ol style="list-style-type: none"> a. If body splash potential exists, wear a butyl rubber or neoprene apron. b. No shorts are allowed 3. <u>Hand Protection:</u> <ol style="list-style-type: none"> a. Medium or heavy weight viton/nitrile/natural rubber gloves (recommend 22 mil) should be worn as the outer glove when working with HF. b. Silver shield is also acceptable for outer gloves c. Note: double gloving should be considered as a Best Practice. d. For higher concentrations (>5%), long chemical compatible gloves (12 inches) should be worn. e. If outer gloves become contaminated, they should be washed before removing. f. Remove gloves in a manner to prevent contamination of the inner glove. g. Thoroughly wash your hands, and check hands for any sign of contamination. h. Contaminated gloves must be disposed of as HF waste.

5.d.

Designated area

1. Emergency Showers and Eyewashes: Any laboratory using Hydrofluoric acid (or any corrosive/caustic chemical) must have an emergency eyewash station accessible within 10 seconds and located in the same room the hazard is being used. Emergency showers must be accessible within 10 seconds and can be located within the room or in the hall way.
2. HF shall be used in Designated Fume Hoods, marked with proper signage to warn others of the possible risk for contamination and exposure. Ensure that fume hood is working properly and have current certification (within last 12 months). Work areas should be cleaned and decontaminated routinely. It is preferable to have a poly sash as HF etches glass and can make the sash cloudy over time.
3. Fire Extinguisher
 - a. A Class ABC fire extinguisher must be available within 10 seconds travel time from where Hydrofluoric acid chemicals are used.
 - b. If a Class ABC sand may be used for small fires
 - c. DO NOT attempt to extinguish large fires or if you are not comfortable to extinguish fires
4. HF Spill and First Aid Kit
 - a. Laboratories that use HF are provided a kit for first aid treatment of dermal, eye, and ingestion exposure. The kit should be located in a visible area where the HF work is being done. The principal investigator or laboratory manager should train all persons working with Hydrofluoric acid on how to respond to a Hydrofluoric acid exposure or spills and how to use the kit.
 - b. Included in the kit is a tube of 2.5 calcium gluconate for dermal exposure.
 - c. The recommended contents of the kit and instructions for use are listed. NOTE: THAT CALICIUM GLUCONATE HAS AN EXPERIATION DATE AND SHOULD BE REGULARLY CHECK THAT IT IS STILL A GEL. IF OPENED THE CALICIUM GLUCONATE NEEDS TO BE REPLACED. Inspect the integrity of the other items in the kit, such as the gloves, to replace as necessary.

Contents: Hydrofluoric acid Spill and First Aid Kit

Tube of 2.5% calcium gluconate gel	Instructions for First Aid Treatment
250 g bottle calcium carbonate	SDS
gloves	
Waste Bags	
Bottle of Milk of Magnesia	

*Please see attached instruction and SDS for Hydrofluoric acid kit

*Please Contact Chemical Safety Coordinator to see if calcium gluconate eye wash

6.	Transport, and storage, receiving requirements
	<ol style="list-style-type: none"> 1. Glass containers should not be used to store or transfer HF, as HF reacts with glass. 2. Ensure all HF containers are clearly labeled. 3. Use chemically compatible secondary containers to store HF in the cabinet or to transport HF containers or mixtures of HF. 4. Hydrofluoric acid must be stored separately from flammables and reducing agents in an approved acid or corrosives safety cabinet. If no corrosive cabinet available, use secondary container to store Hydrofluoric acid. 5. Store in a cool, dry, well-ventilated area away from incompatible substances. 6. Avoid dust formation and control ignition sources. 7. Use proper PPEs, moving carts and precautions, while transporting HF. 8. Store containers on shelves below eye level
7.	Special handling procedures
	<ol style="list-style-type: none"> 1. Hydrofluoric acid can etch glass is should be used in a fume hood with a poly sash and transferred and stored in glass. 2. Experiments that require heating Hydrofluoric acid must: <ol style="list-style-type: none"> a. Be conducted in an area with proper signage on lab door and area of work b. Have written protocol and SOPs. c. Have documented training for all personnel in the lab. 2. NEVER WORK ALONE 1. <u>DO NOT USE STANDARD SPILL KIT AS THE ABSORBER CONTAINS SILICA WHICH FORMS SILCON TETRAFLUORIDE</u> a toxic and corrosive gas. 2. Absorbers <u>must have calcium compounds</u> (e.g., calcium carbonate, calcium sulfate or calcium hydroxide.) 3. Potassium or Sodium Hydroxide (found in many acid-neutralizing kits): <ol style="list-style-type: none"> a. The neutralization of HF with potassium or sodium hydroxide is more exothermic than with sodium or potassium carbonate and a lso generates potassium or sodium hydrogen bifluoride (NaHF₂ or KHF₂) as intermediates, which release gaseous HF when exposed to heat. b. Sodium or Potassium Carbonate (“Soda Ash”, “Caustic Soda”): c. The reaction of Na₂CO₃ or K₂CO₃ with HF generates sodium or potassium hydrogen bifluoride (NaHF₂ or KHF₂) as intermediates, which release gaseous HF when exposed to heat. 4. Sodium bicarbonate should never be used <ol style="list-style-type: none"> a. It does not bind the fluoride ion b. Generates toxic aerosols. <p><u>Note: In case you need to dilute the concentration of Hydrofluoric acid, always add acid to water</u></p>

8.

First Aid

1. Eye:
 - a. **Rapid and immediate decontamination is critical.**
 - b. IF a calcium gluconate eyewash is available, alternate a combination of water eyewash should be used to rinse the eyes for at least 5 minutes, and then treatment of eyes with calcium gluconate eyewash solution followed by the water flush and so on for at least 15 minutes and lifting eyelids occasionally.
 - c. IF a calcium gluconate eyewash is not available, flush with copious amounts of water for at least 15 minutes, lifting eyelids occasionally.
 - d. Remove contact lenses if easily removable without additional trauma to the eye. Do not interrupt flushing.
 - e. Get medical attention immediately.
 - f. Tell the lab PI and Teri Anderson (362-7833)
 - g. Provide the, medical treatment guide, SOP and SDS to emergency responders
2. Inhalation
 - a. Responder should immediately help victim to fresh air if it is safe to do so
 - b. Call 911 and tell them you have a Hydrofluoric acid exposure
 - c. Tell the lab PI and Teri Anderson (362-7833)
 - d. Provide the, medical treatment guide, SOP and SDS to emergency responders
3. Ingestion:
 - a. Do not induce vomiting.
 - b. For ingestion exposures please have the exposed person drink as much of the Milk of Magnesium as possible.
 - c. Call 911 and tell them you have a Hydrofluoric acid exposure and give your exact location
 - d. Tell the lab PI and Teri Anderson (362-7833)
 - e. Provide the, medical treatment guide, SOP and SDS to emergency responders
4. Skin Contact:
 - a. If skin contact occurs, immediately drench in the safety shower with copious amounts of water for at least 5 minutes and alternate with treatment of the skin with calcium gluconate gel. This process should continue for at least 15 minutes.
 - b. If possible to do so without further injury, remove any remaining jewelry or clothing.
 - c. Call 911 and tell them you have been exposed to Hydrofluoric acid and give your exact location
 - d. Tell the lab PI and Teri Anderson (362-7833)
 - e. Provide the, medical treatment guide, SOP and SDS to emergency responders
5. Administer first aid as appropriate.
 - a. Alert people in the vicinity

- b. Remain nearby to advise emergency responders.
- c. Contact EHS, UNM Police, PI, and Chemical Safety Coordinator.

6. **For any exposure,**

- a. FOR ALL HF EXPOSURES EMERGENCY SERVICES MUST BE ACTIVATED AND EXPOSED INDIVIDUALS MUST GO TO THE EMERGENCY ROOM
- b. Double-bag contaminated clothing and personal belongings.
- c. Get medical attention.
- d. Even if the exposure is small, it is still important to be evaluated by a medical professional to determine if follow-up treatment is necessary.

9. **Emergency procedures**

1. **Small liquid spills (<50 ml)**

- a. If you do not feel comfortable cleaning up the spill, call Teri or EHS for help (never put yourself at risk!)
- b. Wear appropriate PPE (i.e., double gloves, lab coat, face shield and goggles).
- c. Spills may only be cleaned with a HF SPILL Kit or by DO NOT USE STANDARD SPILL KIT AS THE ABSORBER CONTAINS SILICA WHICH FORMS SILICON TETRAFLUORIDE toxic and corrosive gas.
- d. Absorbers **must have calcium compounds** (e.g., calcium carbonate, calcium sulfate or calcium hydroxide.)
- e. **Sodium bicarbonate should never be used**
 - i. It does not bind the fluoride ion
 - ii. Generates toxic aerosols.
- f. Pick up (use plastic scoops; do not use combustible materials such as corn whisks or brooms)
- g. Place in a sealed container for proper disposal as hazardous waste. Do not dump down the drain or into the trash.

2. If the spilled material is heated or is greater than 50 ml

- a. Remove ignition sources
- b. Evacuate the laboratory
- c. Close the doors
- d. Call Teri (362-7833) or Bobby (604-6102) or EHS (277-2753 or [afterhours] 951-0194) or UNM Police at 277-2241 or dial 911.

3. **Dry spills**

- a. If you do not feel comfortable cleaning up the spill, call Teri for help (never put yourself at risk!)
- b. Clean up spills in a manner that does not disperse
- c. dust into the air

- d. Reduce airborne dust and prevent scattering by moistening with water-do not flood
- e. Pick up spill (use non-sparking equipment; do not use combustible materials such as corn whisks or brooms)
- f. Place in a sealed container for proper disposal as hazardous waste. Do not dump down the drain or into a waste basket.

10. **Waste disposal**

Identify amounts of waste anticipated and appropriate disposal procedures. Segregate waste by hazard class (for example, flammable, corrosive) and state (solid, liquid), label appropriately, and place in the laboratory's hazardous waste cabinet.

1. **Disposal of Hydrofluoric acid solid contaminated material**

- a. Pipet tips, gloves and other contaminated debris should be collected as hazardous waste.
- b. Bags are ok for dry solids, as long as the bags are sealed closed and labeled properly and there are no free-flowing liquids.
- c. Sharps (needles) must go in puncture-resistant containers.
- d. Do not place dry solids contaminated with chemicals in red or orange biohaz bags.

2. **Disposal of Hydrofluoric acid and waste containing Hydrofluoric acid**

- a. Hydrofluoric acid compounds in manufacture's label may be disposed of as hazardous waste
 - i. Containers must be in good condition or bagged to prevent spillage
 - ii. Lids must fit and be closed when not in use or for pick up
- b. If Hydrofluoric acid is part of a mixture may be disposed of as hazardous waste
 - i. Containers must be compatible with the mixture of waste
 - ii. Containers must be in good condition
 - iii. Containers must remain closed when not in use and for pick up
 - iv. All secondary containers for waste must be labeled with the:
 - 1) Hazardous Waste Label
 - 2) Listing of Contents of the waste
 - 3) Hazards of the mixture (EHS labels have boxes to check for these for ease of use)

- 3. Fill out the Waste Pickup Request located at <https://ehs.unm.edu/waste-management/index.html>

Waste label templates are located at <https://ehs.unm.edu/waste-management/index.html>

11.	<p>Training requirements <i>List the general and laboratory-specific training required</i></p>
	<p><input checked="" type="checkbox"/> Hazard Communication <input checked="" type="checkbox"/> Hazardous Waste Management <input type="checkbox"/> Glove Box Training <input checked="" type="checkbox"/> Basic Safety Training <input checked="" type="checkbox"/> Other: <u>Hydrofluoric acid Training</u></p>
	<p>Additional training requirements <i>List additional, local training requirements.</i></p>
12.	<p>Approval <i>Standard operating procedures must be approved by the laboratory manager and directorate safety coordinator.</i></p>
	<p>Laboratory manager (<i>name, signature, date</i>): _____ Directorate safety coordinator (<i>name, signature, date</i>): _____</p>
	<p>Additional approvals <i>List subject matter experts consulted for approval:</i></p> <p>Person consulted Person consulted</p>
	<p>Additional prior approvals required <i>List any tasks that require prior approval by the principal investigator or laboratory manager (for example, use of restricted chemicals and other higher hazard chemicals and running of higher hazard operations):</i></p> <p>Task requiring prior approval Task requiring prior approval</p>