



Hydrofluoric Acid



Strong Corrosives – Strong Acids (SA) & Acutely Toxic Chemicals (ATC)

Areas with blue text indicate that information must be provided or modified by researcher prior to the SOP approval.

This SOP is not a substitute for hands-on training.

Print a copy and insert into your laboratory SOP binder.

Department:	Chemistry
Date SOP was written:	Monday, October 24, 2016
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	Name: R. Sarpong
	Signature: _____
Internal Lab Safety Coordinator or Lab Manager:	Name: Rebecca Johnson/Melissa Hardy
	Lab Phone: 978-886-5808/406-696-1225
	Office Phone: 510-642-6312
Emergency Contact:	Name: Rebecca Johnson/Melissa Hardy
	Phone Number: 978-886-5808/406-696-1225
Location(s) covered by this SOP:	Latimer Hall
	831,832,834,836,837,838,839,842,844,847,849

1. Purpose

This SOP covers the precautions and safe handling procedures for the use of Hydrofluoric Acid (HF).

If you have questions concerning the applicability of any recommendation or requirement listed in this procedure, contact the Principal Investigator/Laboratory Supervisor or the campus Chemical Hygiene Officer at ucbcho@berkeley.edu



2. Physical & Chemical Properties

Note: Hydrofluoric acid physical and chemical properties are concentration dependent, adjust this data accordingly. If no data are available, write “no data available”.

CAS#: 7664-39-3

Molecular Formula: HF

Form: liquid

Color: colorless

Melting point/freezing point:

Boiling point:

Vapor pressure:

Density:

Flash point:

Lower explosion limit:

Upper explosion limit:

Odor:

Odor Threshold:

3. Potential Hazards/Toxicity

GHS Classification

Acute toxicity, Oral (Category 2)

Acute toxicity, Inhalation (Category 2)

Acute toxicity, Dermal (Category 1)

Skin corrosion (Category 1A)

Serious eye damage (Category 1)

GHS Label elements, including precautionary statements



Pictogram

Signal word

Danger

Hazard statement(s)

H300 + H310 + H330

H314

H318

Fatal if swallowed, in contact with skin or if inhaled

Causes severe skin burns and eye damage.

Causes Serious eye damage

4. Engineering Controls

Use the engineering controls listed below unless other lab-specific information is included in the Protocol/Procedure section.

- Work with HF must be conducted in a fume hood unless other controls are designated in the lab-specific Protocol/Procedure section. Sash height must be kept as low as possible to avoid escaping fumes and provide a physical barrier.
- Laboratories and rooms where strong acids are used must have general room ventilation that is negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.
- The area for working with HF must be appropriately labeled.



5. Personal Protective Equipment

At a minimum, the following PPE must be worn at all times.

Eye and Face Protection

- A. ANSI Z87.1-compliant chemical splash goggles.
 - Ordinary prescription glasses will NOT provide adequate protection unless they also meet ANSI standard and have compliant side shields.
- B. Face shield must be worn over the safety goggles.

Skin and Body Protection

- A. Gloves are required when handling hazardous chemicals.
 - Refer to specific chemical SDS for information on glove selection.
 - For additional information on glove selection, go to:
<http://ehs.berkeley.edu/hs/63-laboratory-safety/94-glove-selection-and-usage.html>
- B. Lab coats are required when handling hazardous chemicals in the lab. Select the type of lab coat according to the substances at the specific workplace.
- C. Long pants, closed-toe/closed-heel shoes, covered legs, and ankles.
- D. Use a long sleeves acid resistant apron when handling HF.

6. First Aid Procedures and Medical Emergencies

In the event of an injury, notify your supervisor immediately and EH&S within 8 hours.



Go to the Occupational Health Facility (Tang Health Center, on campus); if after hours, go to the nearest emergency room (Alta Bates, 2450 Ashby Ave in Berkeley); or



Call 911 (from a cell phone: 510-642-3333) if:

- *it is a life threatening emergency; or*
- *you are not confident in your ability to fully assess the conditions of the environment and/or the condition of the contaminated/injured person, or you cannot be assured of your own safety; or*
- *the contaminated/injured person is not breathing or is unconscious.*

Please remember to provide a copy of the appropriate manufacturer SDS (if available) to the emergency responders or physician. At a minimum, be ready to provide the identity/name of any hazardous materials involved.

In case of skin contact

Immediately (within seconds) proceed to the nearest eyewash/shower and wash the affected area for at least 5 minutes. Remove all contaminated clothing. Wearing compatible gloves (such as nitrile glove), massage calcium gluconate gel into the affected area. Re-apply every 15 minutes.

Call 911 to request assistance and/or emergency transport if needed.

Note: Hydrofluoric acid exposure is often treated with calcium gluconate, a source of Ca²⁺ that sequesters the fluoride ions. HF chemical burns can be treated with a water wash and 2.5% calcium gluconate gel, or special rinsing solutions. However, because it is absorbed, **medical treatment is necessary; rinsing off is not enough**. Intra-arterial infusions of calcium chloride have also shown great effectiveness in treating burns. In some cases, amputation may be required.

In case of eye contact



Immediately (within seconds), proceed to the nearest eyewash station. Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible. Do NOT apply calcium gluconate gel to eyes. **Medical treatment is necessary; rinsing off is not enough.**

Call 911 to request assistance and/or emergency transport if needed.

If swallowed

DO NOT INDUCE VOMITING. Rinse mouth with water; give large quantities of milk (preferable) or water. Never give anything by mouth to an unconscious person. **Medical treatment is necessary.**

Call 911 to request assistance and/or emergency transport if needed.

If inhaled

Move into fresh air.

Needle stick/puncture exposure

Wash the affected area with warm water for 5 minutes. Wearing compatible gloves, massage calcium gluconate gel into the affected area. Re-apply every 15 minutes. **Medical treatment is necessary.**

Call 911 to request assistance and/or emergency transport if needed.

7. Special Handling, Storage, and Disposal Requirements

Lab-specific information on handling HF is included in Section 12, Protocol/Procedure.

Work within sight and/or hearing of at least one other person who is familiar with the hazards and written procedures.

Precautions for Safe Handling

- Work is **not allowed** if calcium gluconate is not available in the laboratory. Calcium gluconate gel must be applied quickly (even if burns have not been felt) to be effective.
- Only use plastic or Teflon lab equipment for manipulating HF solutions.
- Eliminate or substitute for a less hazardous material when possible.
- Design your experiment to use the least amount of material possible to achieve the desired result.
- Do not exceed the scale of procedures specified in Protocol/Procedure section without approval of the PI.
- Verify your experimental set-up and procedure prior to use.
- Know the location of the nearest eyewash, safety shower and fire extinguisher before beginning work.
- Upon leaving the work area, remove any personal protective equipment worn and wash hands.
- At the end of each project, thoroughly decontaminate the work area according to the material being handled.
- Eliminate incompatible materials from the potential spill area (glass, silica, organic solvents).

Conditions for Safe Storage

- HF must always be stored in polyethylene containers. DO NOT store HF in glass bottles/containers.
- Store in corrosive/acid storage cabinet within a polyethylene secondary containment.
- Do not store in the topmost shelf of the storage cabinet.
- Do not store with oxides, organic chemicals, bases or metals.



- Carefully carry the stock bottle in a Rubbermaid bottle carrier/polyethylene secondary container to the chemical fume hood and pour out desired amount into a smaller container.
- Place stock bottle back in corrosive/acid storage chemical storage cabinet with cap tightly closed.

Disposal

- Collect HF liquid/solid waste in a polyethylene container dedicated to HF ONLY!
- BE SURE NOT TO MIX HF-alcohol waste with HF-nitric waste. The result will be explosive!
- The empty container must be rinsed three times with a COMPATIBLE solvent; leave it open in the back of the hood overnight. Solvent rinses and water rinse must be disposed of as hazardous waste.
- Any empty container which once held HF must be disposed of as hazardous waste.
- Do not mix with incompatible waste streams.
- Decontamination of the empty container in order to use it for other purposes is not permitted.

8. Chemical Spill

Spill – Assess the extent of danger; request help by calling **911** (from a cell phone: **510-642-3333**) for emergency assistance or 510-642-3073 for non-life threatening situations. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors from spill. If possible, confine the spill to a small area using a spill kit or absorbent material. If such absorbents are not available, a large excess of dilute, aqueous calcium or magnesium hydroxide ($\text{Ca}(\text{OH})_2$ or $\text{Mg}(\text{OH})_2$) can be employed. The neutralization must be performed slowly in order to avoid an exothermic reaction (heat will vaporize HF and increase the risk of exposure). Keep others from entering contaminated area.

Do NOT attempt to neutralize HF with the following:

- 1) Sodium or Potassium Carbonate (“Soda Ash”, “Caustic Soda”): The reaction of Na_2CO_3 or K_2CO_3 with HF generates sodium or potassium hydrogen bifluoride (NaHF_2 or KHF_2) as intermediates, which release gaseous HF when exposed to heat.
- 2) Potassium or Sodium Hydroxide (found in many acid-neutralizing kits): The neutralization of HF with potassium or sodium hydroxide is more exothermic than with sodium or potassium carbonate and also generates potassium or sodium hydrogen bifluoride (NaHF_2 or KHF_2) as intermediates, which release gaseous HF when exposed to heat.
- 3) Silicon-based absorbent materials (common in most solvent spill kits) react with HF to generate silicon tetrafluoride, which is a toxic and corrosive gas.

9. Cleaning and Decontamination

HF is listed as Extremely Hazardous (EH) Substance by the State of California. Even the containers (irrespective of the size) which once held HF must be disposed of as hazardous waste with an on-line hazardous waste tag affixed on the container. Even the chemical resistant gloves that come in contact with HF (i.e., HF contaminated gloves) must be disposed of as dry hazardous waste. All dry hazardous waste must be double bagged and affixed with an on-line waste tag.

10. Hazardous Waste Disposal

Label Waste



Label all waste containers with a label provided at
<http://ehs.berkeley.edu/hm/279-new-hazardous-waste-program-hwp.html>.

See the EH&S Fact Sheet, “Hazardous Waste Management” for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

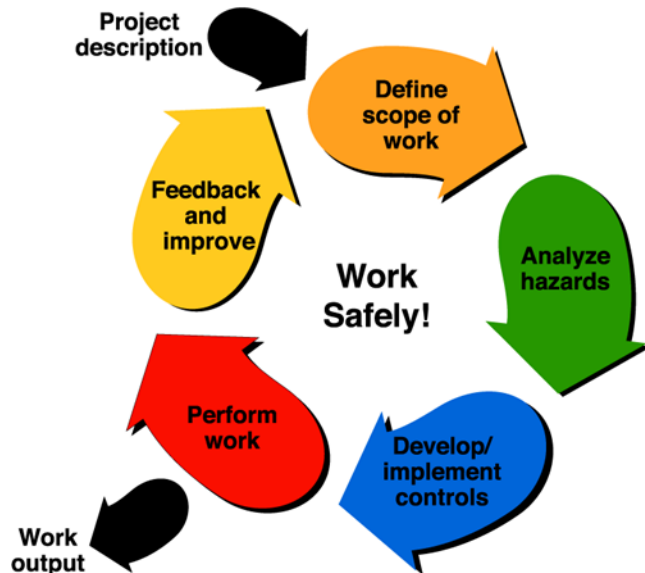
- Collect all HF liquid waste in labeled plastic containers.
- **BE SURE NOT TO MIX HF-alcohol waste with HF-nitric acid waste. The result will be explosive!**
- Store hazardous waste in closed plastic containers, in secondary containment, and in a designated location. Do not store waste in glass containers.
- Dispose of regularly generated chemical waste within 6 months.
- Contact EH&S at 642-3073 if you need assistance.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at <http://ucsd.com>



-Take Ownership of Your Safety-



Before starting any work, ask yourself:

- 1- **What will I be doing?**
- 2- **Do I know what the hazards are?**
- 3- **Do I have everything I need to do the job safely?**
- 4- **Am I doing the job safely?**
- 5- **What can we do better?**



12. Protocol/Procedure – Hydrofluoric Acid

Section 12 must be customized to your specific needs. Delete any procedure that does not apply to your laboratory.

Note: Calcium Gluconate Gel

Calcium gluconate gel is a topical antidote for HF skin exposure. Calcium gluconate works by combining with HF to form insoluble calcium fluoride, thus preventing the extraction of calcium from tissues and bones. Keep calcium gluconate gel nearby whenever you're working with HF. Calcium gluconate can be ordered through scientific supply companies. Calcium gluconate has a limited shelf life and should be stored in a visible, and replaced with a fresh supply after its expiration date has passed. Use disposable exam gloves to apply calcium gluconate gel. Even after applying calcium gluconate, it is essential that a medical evaluation be made.

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
1. Creating stock solutions (from concentrated HF as supplied in the reagent bottle).	Up to 500 mL of 5% HF stock solution. Remember to obtain PI approval if higher scale is necessary.	All work must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox. All equipment must be Nalgene or Teflon based. All exposure to or contact with HF must receive immediate first aid and medical evaluation, even if the injury appears minor or no pain is felt. HF can produce delayed effects and serious tissue damage without necessarily producing pain.	Eye protection: Wear ANSI approved chemical goggles, not safety glasses. Face protection: Face shield must be worn over the goggles when handling HF. Hand protection: Confirm compatibility of glove material with HF. General guidance (unless otherwise specified in the specific SDS): medium weight (11 mil minimum) or heavy weight (18 mil minimum) Viton, neoprene, nitrile, or natural rubber gloves are worn when working with HF, depending on concentration and volume of HF used. Immediately change gloves if they become contaminated with HF. Wear gloves (e.g. nitrile) underneath to protect against leaks. Gloves must be inspected prior to use. Wash and dry hands after use.	Use plastic or Teflon labware when preparing HF solutions; HF readily etches glass and concentrated solutions can corrode metal. Teflon is hydrophobic so it helps to minimize spills of HF solutions. Be sure to have a pipette and a container ready. Determine the volume of solution you need before dispensing acid. Transfer concentrated hydrofluoric acid into a temporary beaker to make handling easier. Measure out the required amount of water needed for the solution. Using the pipette, slowly add the appropriate amount of acid to the water until the desired concentration is reached. Line work surfaces with plastic-backed absorbent paper and/or a containment tray of compatible material. Once work with HF is complete, decontaminate the area by wiping it down with a 10% calcium carbonate (CaCO ₃) solution or dry magnesium sulfate (MgSO ₄). Store stock solutions in acid cabinet with



Hydrofluoric Acid

Chemical Specific Standard Operating procedure

Berkeley EH&S

			<p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed and close-heeled shoes. <u>Use a long sleeves acid resistant apron when handling HF.</u></p>	<p>concentrated HF.</p> <p>Once work with HF is complete, dispose of any residual HF acid as hazardous waste.</p> <p>NOTE: Use a separate waste container, clearly labeled so that no other liquid or solid waste is added to the container.</p>
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eyes, face, gloves, clothing)	Procedure Steps and Precautions
<p>2. Use of (stock) solutions of HF.</p>	<p>Up to 500 mL of 5% HF stock solution.</p> <p>Remember to obtain PI approval if higher scale is necessary.</p>	<p>All work must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.</p> <p>All equipment must be Nalgene or Teflon based.</p> <p>All exposure to or contact with HF must receive immediate first aid and medical evaluation, even if the injury appears minor or no pain is felt. HF can produce delayed effects and serious tissue damage without necessarily producing pain.</p>	<p>Eye protection: Wear ANSI approved chemical goggles, not safety glasses.</p> <p>Face protection: Face shield must be worn over the goggles when handling HF.</p> <p>Hand protection: Confirm compatibility of glove material with HF. General guidance (unless otherwise specified in the specific SDS): medium weight (11 mil minimum) or heavy weight (18 mil minimum) Viton, neoprene, nitrile, or natural rubber gloves are worn when working with HF, depending on concentration and volume of HF used. Immediately change gloves if they become contaminated with HF. Wear gloves (e.g. nitrile) underneath to protect against leaks. Gloves must be inspected prior to use. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed and close-heeled shoes. <u>Use a long sleeves acid resistant apron when handling HF.</u></p>	<p>Use plastic or Teflon labware when preparing HF solutions; HF readily etches glass and concentrated solutions can corrode metal. Teflon is hydrophobic so it helps to minimize spills of HF solutions.</p> <p>Ensure that all equipment is clean and free from incompatible materials, and that there is no glass that will be in contact with the hydrofluoric acid.</p> <p>Determine the volume of solution you need before dispensing acid.</p> <p>Using a pipette, slowly transfer the acid into your reaction vessel.</p> <p>Immediately change gloves if they become contaminated with HF.</p> <p>Once work with HF is complete, decontaminate the area by wiping it down with a 10% calcium carbonate (CaCO₃) solution or dry magnesium sulfate (MgSO₄).</p> <p>Once work with HF is complete, dispose of any residual HF acid as hazardous waste.</p> <p>NOTE: Use a separate waste container, clearly labeled so that no other liquid or solid waste is added to the container.</p>
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eyes, face, gloves, clothing)	Procedure Steps and Precautions
<p>3. Cleaning Glassware with diluted HF solution.]</p>	<p><100 mL of 5% HF stock solution.</p> <p style="color: red;">Remember to obtain PI approval if higher scale is necessary.</p>	<p>All work must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.</p> <p>All equipment must be Nalgene or Teflon based, including tweezers.</p> <p>All exposure to or contact with HF must receive immediate first aid and medical evaluation, even if the injury appears minor or no pain is felt. HF can produce delayed effects and serious tissue damage without necessarily producing pain.</p>	<p>Eye protection: Wear ANSI approved chemical goggles, not safety glasses.</p> <p>Face protection: Face shield must be worn over the goggles when handling HF.</p> <p>Hand protection: Confirm compatibility of glove material with HF. General guidance (unless otherwise specified in the specific SDS): medium weight (11 mil minimum) or heavy weight (18 mil minimum) Viton, neoprene, nitrile, or natural rubber gloves are worn when working with HF, depending on concentration and volume of HF used. Immediately change gloves if they become contaminated with HF. Wear gloves (e.g. nitrile) underneath to protect against leaks. Gloves must be inspected prior to use. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed and close-heeled shoes. <u>Use a long sleeves acid resistant apron when handling HF.</u></p>	<p>Use plastic or Teflon labware when preparing HF solutions; HF readily etches glass and concentrated solutions can corrode metal. Teflon is hydrophobic so it helps to minimize spills of HF solutions.</p> <p>Ensure that all equipment is clean and free from incompatible materials, and that there is no glass that will be in contact with the hydrofluoric acid.</p> <p>Soak the glassware for approximately 5 min in 5% HF solution.</p> <p>Rinse with DI water at least 3 times.</p> <p>Once cleaning is complete, dispose of any residual HF acid as hazardous waste.</p> <p><i>NOTE: Use a separate waste container, clearly labeled so that no other liquid or solid waste is added to the container.</i></p>
Notes	Any deviation from this SOP requires approval from PI.			



13. Documentation of Training (signature of all users is required)

- Prior to conducting any work with HF, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.

I have read and understand the content of this SOP:

Name	Signature	Identifier	Date