

# EHS Laboratory Guidance

## Hydrofluoric Acid

### Introduction

Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties that make handling this material especially hazardous. Anhydrous hydrofluoric acid is a clear, colorless, fuming, corrosive liquid. HF is also available in the gaseous state. All forms of HF can cause severe burns to tissue. In university laboratories, HF is typically encountered as a 48% aqueous solution. The Principal Investigator (PI) should use this guidance document and the product-specific Safety Data Sheet (SDS) to train employees/students who handle hydrofluoric acid on its hazards and what to do in the event of an exposure, spill or other emergency. The SDS and this guidance document should be kept in the immediate work area where HF is used. Each lab should create a lab-specific standard operating procedure (SOP) for using HF.

### Uses

HF is used in the fabrication of electronic components, to etch glass and in the manufacture of semiconductors. Due to its ability to dissolve oxides, HF is useful in preparing powdered rock samples for analysis. Dilute hydrofluoric acid solutions are employed in some biological staining procedures, as well as in commercial products such as household rust stain remover and "wheel cleaner" compounds.

### Chemical Properties

HF solutions are clear and colorless with a density similar to that of water. The most widely known property of HF is its ability to dissolve glass. It will also attack glazes, enamels, pottery, concrete, rubber, leather, many metals (especially cast iron) and organic compounds. Upon reaction with metals, explosive hydrogen gas may be formed. Use and store HF in polyethylene, polypropylene, or Teflon containers.

### Toxicological Properties

In general, elevated levels of fluoride ions are both acutely and chronically toxic. Acute symptoms of HF exposure include extreme respiratory irritation, immediate and severe eye damage, and pulmonary edema. Skin, eye, or lung exposure to concentrated (>50%) HF solutions will cause immediate, severe, penetrating burns. Exposure to less concentrated solutions may have equally serious effects, but the appearance of symptoms can be delayed for up to 24 hours. Studies have suggested that HF at concentrations as low as 0.01% could possibly cause injury to the more sensitive areas of human skin following exposures as short as 5 min. **If you are exposed to HF, seek medical attention immediately, even if you do not feel pain.**

### Exposure Control, PPE and Work Practices

The ACGIH ceiling limit and OSHA 8-hour time-weighted average (TWA) for HF is 3ppm. Local ventilation such as a fume hood should always be used when working with HF.

The purpose of personal protective equipment (PPE) is to shield the individual in the event of a release of vapor, a splash, a spill or other incident. PPE is not a substitute for safe work practices. Complete a [Laboratory Hazard Analysis Form](#) prior to using HF or whenever a significant change in procedure occurs. Eye protection in the form of safety goggles and a face shield must be worn. Neoprene, Nitrile (22mil), or other HF resistant gloves should be worn. **Latex gloves do not** protect against HF. It is recommended to use an acid resistant suit or apron since clothing may absorb HF and maintain it close to the skin.

## Using Hydrofluoric Acid Safely

It is the responsibility of the PI to ensure that personnel are properly trained in the safe use of HF.

1. **Never use hydrofluoric acid when working alone or after hours.** HF may be used when working alone ONLY during normal business hours AND provided knowledgeable laboratory personnel have been alerted and at least one is in the general vicinity (buddy system). It is the responsibility of the PI to ensure that personnel are using this buddy system.
2. All lab personnel, whether using HF or not, should be informed of the dangers of this chemical and the emergency procedures necessary in case of an accident. A sign should be posted on the door to the lab room to alert people that work with HF is in progress.
3. All persons using HF must be made aware of its properties and trained in proper procedures for use and disposal.
4. Labs that use HF in any form must have an operational safety shower and eye wash within their laboratory. Before beginning any procedure involving HF, ensure the access to the emergency shower and eyewash is unobstructed, and that the shower/eyewash has been recently flushed by lab personnel according to EHS guidelines.
5. Undergraduate students should never be given the task of mixing HF solutions. Only experienced persons familiar with its properties should handle the concentrated acid.
6. Report **all** spills to EHS.
  - a. For small spills (100 ml or less) of **dilute** HF solution, clean it up using the HF spill cleanup material listed below. Submit a [chemical waste collection request](#) to EHS to dispose of the contaminated cleanup materials.
  - b. For larger spills, or any amount of concentrated HF, contain the spill as best you can, evacuate the area, and call EHS (208-885-6524) during regular business hours; otherwise, call 911. Avoid exposure to HF vapors.
7. Dispose of unwanted HF by submitting a [chemical waste collection request](#) to EHS.
8. When working with HF:
  - a. Work in a fume hood with the sash as low as possible.
  - b. Wear proper PPE, as mentioned above.
9. Any exposure to HF must be medically evaluated.
10. Report exposures by following the instructions on the online [Accident Incident Report Form](#).

## Storage and Disposal

1. Store HF in plastic containers that are rated for this use.
2. Store unused HF with other mineral acids.
3. If the storage cabinet does not have an integrated spill tray, store HF in some form of secondary containment.

4. Mark all secondary containers with the product name and appropriate GHS Hazard Communication statements or pictograms (“Corrosive” and “Toxic”).
5. Submit unneeded stock material for disposal through EHS. Indicate under the “Additional Information” section that the material is stock (i.e., unused).
6. Collect spent HF solutions in plastic containers and submit for disposal through EHS.

## HF Exposure/Spill Kit

An HF exposure/spill kit must be available and located in the laboratory area where HF work is performed; **it is the responsibility of the PI to ensure that this kit is present in the immediate work area and properly stocked.** The purpose of the spill kit is to contain and stabilize an HF spill while EHS is called. EHS will clean up HF spills.

Inspect the exposure/spill kit regularly (at least monthly) to ensure it is fully stocked. The kit must contain:

1. At least one, 25g tube of calcium gluconate gel, 2.5%; available from commercial vendors.  
  
Inspect the gel before **every** use of HF and at least monthly to ensure the gel container is unopened and has not reached the **expiration date**. Open tubes of calcium gluconate and tubes that have expired must be discarded and replaced with a new container before work with HF can proceed.
2. Calcium or magnesium-based antacids, to be ingested by the victim.
3. Two (2) pairs of Neoprene or Nitrile (22mil) gloves.
4. One (1) pair of goggles.
5. One (1) heavy-duty polyethylene bag to be used for items contaminated by HF.
6. Spill material specific for hydrofluoric acid.
7. A copy of these procedures and the Safety Data Sheet (SDS) to take to the emergency room, if necessary.

## Emergency Response Procedures

### Universal Procedures for ALL HF Exposures

1. Call 911 and inform the dispatcher that there has been a hydrofluoric acid exposure. Include the exact location (building and room number), the name of the victim and any other relevant information requested.
2. Anyone assisting the victim should wear PPE found in the HF exposure/spill kit to prevent cross-contamination.
3. Note any treatment provided and the time given; provide EMS with this information upon their arrival.
4. The “Caution – Hydrofluoric Acid Exposure” form (last page of this document) should be presented to emergency responders and taken to the hospital along with the HF SDS and the rest of this document.

### Additional Procedures for Specific Exposure Sites

### **Skin Exposure**

1. The victim should remove affected clothing along with any jewelry or other extra articles of clothing. The victim should use the safety shower/eyewash for at least 15 minutes.
2. After the affected area is flushed with water, have the victim apply calcium gluconate gel to the area. If the victim is unable to self-apply, anyone can apply the gel after putting on the gloves in the HF exposure kit. Note the time when the calcium gluconate gel was first applied to the skin. Provide this information to the EMS team when they arrive.

### **Eye Exposure:**

1. Immediately flush eyes for at least 15 minutes.
2. The victim should then be transported to a medical facility by EMS.

### **Inhalation:**

1. If safe to do so, immediately remove the victim to clean air.
2. Inhalation of hydrofluoric acid fumes may cause swelling in the respiratory tract up to 24 hours after exposure. Persons who have inhaled hydrofluoric acid vapors may need prophylactic oxygen treatment and must be seen by a physician as soon as possible.

### **Ingestion:**

1. Have the victim drink 4 – 8 ounces of water or milk as quickly as possible. **Do not induce vomiting.** Do not give emetics (vomit inducing agents) or baking soda. If vomiting occurs, use extreme caution as it may contain hydrofluoric acid.

**Never give anything by mouth to an unconscious person.**

2. If directed by the 911 dispatcher, drink several ounces of Milk of Magnesia, Mylanta, Maalox or similar product, or eat up to 30 Tums, Caltrate or other calcium or magnesium based antacid tablet. Calcium and magnesium can bind with HF and may act as an antidote.

### **References**

Calgonate®. (n.d.). HF Safety Information. Retrieved from [http://calgonate.com/safety\\_info.php](http://calgonate.com/safety_info.php)

Medscape (Medical Treatment and Exposure): <https://emedicine.medscape.com/article/773304-overview>

### **List of Abbreviations:**

- ACGIH: American Conference of Governmental Industrial Hygienists  
EHS: Environmental Health & Safety (University of Idaho)  
EMS: Emergency Medical Services  
GHS: Globally Harmonized System  
OSHA: Occupational Safety and Health Administration (federal agency)  
PPE: Personal protective equipment (gloves, goggles, lab coats, etc.)  
TWA: Time-weighted average - the average exposure to any hazardous gas in the workplace based on an eight-hour workday or 40-hour work week.

# Caution – Hydrofluoric Acid Exposure

This person was exposed to Hydrofluoric Acid (HF)

**DO NOT** treat as a simple chemical burn - HF quickly and deeply penetrates tissues and requires specialized treatment

## For All Treatment Personnel

Protect yourself and your staff:

**Do not** touch the victim with your bare hands

**Do not** use latex gloves

**Use nitrile gloves** when touching the patient or removing their clothing

## General Information/Medical Concerns

- HF is a very toxic and corrosive acid
  - HF reacts with glass, metals, organic compounds (including latex), and many other substances
  - HF binds to calcium and magnesium resulting in demineralization of body tissues
- Exposure of less than 10% of the body to HF can be fatal
- In high concentration, HF exposure can lead to systemic toxicity
- **Patient requires ECG and cardiac monitor**
- Cardiac symptoms can be delayed up to 24 hours after skin exposures
- HF exposure can cause hypocalcemia, cardiac arrhythmias, metabolic imbalances, pulmonary edema