



# ENVIRONMENTAL HEALTH & SAFETY

The University of Alabama at Birmingham

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## Safe Handling, Storage and Disposal of Hydrofluoric Acid

### Introduction

Hydrofluoric acid (HF) is a highly corrosive inorganic acid. HF must be handled with extreme caution because it can penetrate the skin extremely easily and decalcifies bones leading to tissue necrosis, which may result in amputation and death. Severity and rapidity of onset of signs and symptoms depends on the route of exposure, concentration of the acid, duration of exposure, and the penetrability of the exposed tissue. In case of exposure emergency procedures should be instituted IMMEDIATELY and whenever there is any reason to suspect exposure to the chemical.

**OSHA Permissible Exposure Limit (PEL) - General Industries: 3 ppm  
(2 mg/m<sup>3</sup>) TWA**

**National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL): 3 ppm (2.5 mg/m<sup>3</sup>) TWA, 6 ppm (5 mg/m<sup>3</sup>) Ceiling (15 minutes)**

**American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2005): 0.5 ppm TWA, 2 ppm Ceiling**

**NIOSH Immediately Dangerous To Life or Health Concentration (IDLH): 30 ppm**

**Any laboratory at UAB that uses or store hydrofluoric acid (HF) must maintain a commercially prepared gel of calcium gluconate in the laboratory area.**

- Concentrated HF, liquid or vapor, may cause sever burns, electrolyte imbalance, pulmonary edema and or life threatening cardiac arrhythmias.
- Hydrogen fluoride goes easily and quickly through the skin and into the tissues in the body. There it damages the cells and causes them to not work properly.
- Even moderate exposure may rapidly progress to fatality if not treated promptly and properly.
- Symptoms of exposure may be delayed in some cases for several hours, therefore, immediate medical intervention is necessary even in the absence of any symptoms

**An area the size of the hand (approx. 2.5% of the body surface area) is generally seen as the minimum for potential lethal action following contact with concentrated hydrofluoric acid.**

## Health Hazards

### *Minimum Lethal Exposure*

#### ORAL

- Death has occurred after ingestion of 1.5 grams of hydrofluoric acid (concentration unknown) within 6.5 hours of ingestion.

#### DERMAL

- A dermal exposure to 70 percent hydrofluoric acid over a 2.5 percent total body surface area resulted in death.

#### INHALATION

- The lowest lethal concentrations for hydrogen fluoride range from 50-250 ppm for 5-minute exposure and are based on accidental, voluntary and occupational exposure information.

## Preparing to Work with HF

1. Before starting to order HF, do the following:
2. Read an MSDS for HF.
3. Read this document
4. Create a Standard Operating Procedure (SOP) for the process, incorporating information contained in this document.
5. Obtain an HF specific first aid kit (calcium gluconate gel, [http://www.calgonate.com/calgonate\\_gel.php](http://www.calgonate.com/calgonate_gel.php))

6. Obtain a HF specific spill kit( <http://www.newpig.com/pig/US/pig-hydrofluoric-acid-neutralizing-spill-kit-in-bucket-kit601>)

## Emergency equipment

- Areas where HF is used must have access to an eyewash and safety shower within 10 seconds.
- Emergency showers must be accessible from any point in the lab or work area within 10 seconds. Eyewashes should be accessible from any point in that lab or work area within 10 seconds.
- The eyewash shall be located on the same level as the hazard and the path of travel shall be free of obstructions that may inhibit its immediate use. Please note, handheld eyewash bottles or self-contained units are not acceptable alternatives to plumbed eyewash units.

## Working Safely with HF and Required PPE

**Always read about the safe work practices, spill control methods and emergency procedures before starting the work**

- Always work under a working chemical fume hood. **Before use, always check the fume hood is certified and working properly.** Manipulation involving even small quantities of dilute HF solutions **must be performed inside the hood.** Placing plastic trays or bench paper on the work surface can prevent contamination of the work surfaces before starting HF procedures.
- Gloves: Heavy neoprene or nitrile rubber gloves are the best for working with HF; but the thickness may reduce agility. Wear two pairs of nitrile exam gloves and change them often instead. When working with larger quantities of HF in procedures that do not require as much agility, wear heavy nitrile or neoprene rubber gloves, with a nitrile exam glove underneath. Check the gloves for leaks by inflating the glove and then closing the cuff. An intact glove should hold air (you may also submerged in water and look for bubbles).
- Body Protection: long-sleeved shirt, long pants, and closed-toe shoes. Always wear a lab coat, chemical-resistant apron and sleeves.
- Eye Protection: Goggles, along with a face shield
- Never work alone with HF and limit all HF manipulations to regular office hours.
- Only trained personnel are allowed to work with HF.
- Keep the acid deep inside the fume hood as far away as possible from the user
- Use plastic beakers and containers for HF manipulations and always check for cracks and brittleness.
- Wash hands thoroughly with soap and water after handling HF.

## Emergency Procedures

**ALL HYDROFLUORIC ACID EXPOSURES ARE A MEDICAL EMERGENCY!  
IMMEDIATELY ARRANGE FOR MEDICAL HELP. MEDICAL PERSONNAL**

## **SHOULD BE WARNED ABOUT HF AND A COPY OF SDS MUST BE PROVIDED TO THEM.**

Strong acid concentrations (over 50%) “cause immediate, severe, burning pain and a whitish discoloration of the skin which usually proceeds to blister formation.” In contrast, the effects of more dilute solutions may be delayed. **The latency period for symptoms (redness, swelling, and blistering) to appear after exposure to aqueous HF solutions in the 20-50% range may be up to eight hours.** Solutions less than 20% may not produce symptoms for up to twenty-four hours.

All exposure to or contact with HF shall receive immediate first aid and medical evaluation even if the injury appears minor or there is no sense of pain. HF can produce delayed effects and serious tissue damage without necessarily producing pain.

In the event of an HF exposure get medical help by following UAB emergency response plan <https://www.uab.edu/ehs/chemical-safety/lab-emergency-resource>. Immediately start the first aid procedures described below to avoid HF burns or other permanent damage.

### **Skin Exposure or Burn**

In the event of a burn caused from HF, the following steps must be immediately taken:

- The skin must be copiously washed with water, beginning immediately after exposure.
- Remove all clothing while in the shower (remove goggles last; double-bag contaminated clothes, When removing shirts or pullover sweaters, be careful not to contaminate the eyes. Cutting off such clothing will help prevent spreading the contamination. Do not put contaminated cloths back; they may still contain chemical residue. Wash contaminated clothing separately or discard.). while you are in the shower let someone call 911
- If 2.5% calcium gluconate gel or 0.13% benzalkonium chloride is available, washing can be stopped after 5 minutes and start applying the ointment. 5 minutes of washing will effectively remove all the HF from the body and extra washing will only delay the treatment. If the neutralizing agents are not available keep rinsing until medical help arrive.
- Apply calcium gluconate gel (2.5%) while wearing gloves. Massage the gel promptly and repeatedly into burned area. Always follow the manufacturers directions supplied with the HF burn ointment/solution if they differ from these.
- Seek immediate medical attention.

### **Ingestion of HF**

- Call emergency help immediately **by dialing 911 from campus phone and 205-934-3535 form cell phone.**
- Drink large amounts of water. Do not induce vomiting.

- If the injured person is unconscious, turn his/her head or entire body onto the left side. Be cautious about performing CPR. This could potentially poison you from the mouth-to-mouth contact. If available, use a mouth-to-mouth resuscitator.

### Inhalation of HF

- Evacuate the area and move the victim to fresh air.
- Immediately **by dialing 911 from campus phone and 205-934-3535 form cell phone.**
- Breathe 100% oxygen (10 to 12 L/min flow rate) as soon as possible.
- Trained personnel should provide calcium gluconate (2.5%) by nebulizer.
- Get medical attention
- Treat the person for chemical burns of the eyes and skin.

### Contamination on clothing

- Immediately remove all contaminated clothing, including shoes, undergarments, and jewelry, while standing under running water or the safety shower.
- When removing shirts or pullover sweaters, be careful not to contaminate the eyes. Cutting off such clothing will help prevent spreading the contamination.
- Do not put contaminated clothing back on, they still contain chemicals
- Wash contaminated clothing separately or discard.
- Call **by dialing 911 from campus phone and 205-934-3535 form cell phone** to have the victim taken to the emergency room for medical attention.

### Transporting HF

- If an HF containing solution must be transported:
  - Place the object in a clean, chemically compatible container and close the lid.
  - Remove your gloves before transporting the container to avoid the possibility of chemical contamination on your gloves spreading to door handles and other objects.
  - Or consider putting on a single clean glove with which to carry the container, leaving an ungloved hand to open doors and handle other objects.
  - Or have a lab member open doors and handle objects for you.

### Spill Management

Any laboratory at UAB that uses or store hydrofluoric acid (HF) must maintain a commercially prepared gel of calcium gluconate in the laboratory area. The gel is used for immediate treatment of skin exposures to HF. HF causes serious damage to tissues and bones. Faster the treatment the smaller the chance of serious injury

**All areas where HF is used must have proper spill control kit.** Small spills can be neutralized by covering with acid neutralizer/sodium bicarbonate, and absorbed with spill control pads/absorbents. Proper PPE must be worn before starting the cleanup.

**If HF is spilled outside of a chemical hood: never try to clean up; contact EH&S at 205-917-4766**

- Evacuate the area.
- Close the doors;
- Post the area with a sign to prevent others from entering; and
- Notify EH&S at 205-917-4766 and call dialing 911 from campus phone or 205-934-3535 from cell phone.

**Laboratory staff can clean up spills of up to 50ml of HF inside a chemical fume hood** (every lab using HF must have a spill kit) by containing the spillage and carefully neutralizing the spill with:

- Spill-X-C caustic neutralizer
- Caustic soda;
- Powdered calcium carbonate
- Calcium hydroxide; or
- Using a commercial HF spill kit-[HF Specific Spill Kit](#)

## **HF Waste Management**

HF waste shall be placed in a chemically compatible container (e.g. polyethylene or Teflon®) with a sealed lid and clearly labeled. **Do not store HF waste in glass or metal containers.**

## **Incompatibles and Storage**

HF must be stored in tightly closed containers made of polyethylene or fluorocarbon plastic or lead. Store HF in a cool and dry place away from incompatible materials separated from other chemicals. **NEVER STORE HF IN GLASS CONTAINERS!** Hydrofluoric acid reacts with many materials therefore avoid contact with glass, concrete, metals, water, oxidizers, reducers, alkalis, combustibles, organics and ceramics. **Secondary containment of polyethylene must also be used. The storage area must have warning signs posted outside the cabinets.** Storage facilities must have adequate ventilation.

Containers of HF may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

**Any lab working with HF must keep Calcium gluconate gel on-site. It is the responsibility of the PI to maintain an up-to-date stock. Minimally, the PI must inform employees about the presence and location of the gel, advice to use it, and this policy before they can work with HF.**

## **Information and Training**

- The Principle Investigator shall train employees who handle hydrofluoric acid on the hazards of HF and what to do in the event of an exposure or a spill or other emergency.
- The SDS together with this policy shall be used to train employees on the hazards of HF

- A Material Safety Data Sheet (SDS) on HF must always be kept in the immediate work area where HF is used.

## Hydrofluoric acid checklist

Prior to ordering hydrofluoric acid or bringing it into the laboratory, the Principal Investigator is responsible for reviewing this checklist and ensuring that all required items mentioned below are immediately available in the laboratory and in good working order.

Each day before beginning any work involving HF, ensure that the following items are in place:

- Arrangements with local medical resources have been made to ensure that medical personnel are familiar with the toxicity and treatment of HF exposure.
- A colleague with training of the HF SOP is available and aware that work with HF will be conducted.
- First aid, spill procedures and HF SDS are immediately available in HF work area.
- Proper functioning of chemical hood has been verified.
- Eyewash and emergency shower are functioning and access is unobstructed.
- An adequate supply of calcium gluconate gel is available and within its expiration date.
- Necessary personal protective equipment items are available.
- HF spill kit is available in case of spill.
- Phone: locate and decide in advance what kind of emergency help should be sought--see emergency section. Remember 911 (give building and room number). The phone should post emergency phone numbers, name of building, building number, and room numbers.

## References

1. <http://www.bt.cdc.gov>
2. AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 40:215±220 (2001)
3. First aid for a unique acid, HF: A sequel By Eileen B. Segal, Chemical Health & Safety, January/February 2000
4. <http://www.epa.gov>

## HF Spill kit

<http://www.newpig.com/pig/US/pig-hydrofluoric-acid-neutralizing-spill-kit-in-bucket-kit601>