

Standard Operating Procedure

Use of Hydrofluoric Acid

Facility: ERC Clean Room
C17 Engineering Research Complex
Electrical and Computer Engineering

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Scope: This SOP details appropriate safety procedures for the use of hydrofluoric acid in the ECE Clean Room.

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Introduction:

Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties that make handling this material particularly hazardous. Anhydrous HF is a clear, colorless, fuming, corrosive liquid. HF is also available in the gaseous state. All forms including the solution or the vapor can cause severe burns to tissue.

Concentrated hydrofluoric acid is used in the fabrication of electronic components, to etch glass and in the manufacture of semiconductors. It is also used by geologists to dissolve sedimentary rock. Dilute hydrofluoric acid solutions are used in some biological staining procedures.

Hydrofluoric acid solutions are clear and colorless with a density similar to that of water. HF is a systemic toxin that may result in severe hypocalcaemia, hypomagnesaemia, hyperkalemia, metabolic acidosis, cardiac dysrhythmias and death. HF may produce severe ocular and dermal injury as well as acute life threatening systemic toxicity with minimal external tissue damage.

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. HF must be used and stored in polyethylene, polypropylene, Teflon, wax, lead or platinum containers.

Toxicology:

Fluoride ions are both acutely and chronically toxic. Acute effects 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. If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.

Exposure Control:

The ACGIH ceiling limit and OSHA TWA for HF is 3 PPM. Local exhaust ventilation should always be used when working with HF. Industrial Hygienists from the Department of Environmental Safety are available to determine personal exposures if inhalation is possible. Contact (301) 405-3980 for more information.

Personnel:

1. Employees who handle HF must receive documented training on the hazards of HF and what to do in the event of an exposure or a spill.
2. A Material Safety Data Sheet (MSDS) on HF should be kept in the immediate work area where HF is used. The MSDS, together with this Fact Sheet, is an excellent basis for training employees on the hazards of HF.
3. No employee or student shall work alone with HF.
4. All employees and students working with HF will wash their hands when finished working with the chemical.

Safety:

1. HF must only be handled in a properly functioning fume hood.
2. HF should only be used in the smallest amount possible.
3. Containers containing HF must be tightly closed and properly labeled.
4. Empty containers must be treated with caution and as hazardous waste.
5. Proper personal protection equipment (PPE) is required at all times when handling HF
6. Care should be taken to prevent any skin contact with gloves that were used to handle HF, even when contamination of the gloves is not suspected.

Procedures:

I. Personal Protective Equipment:

The purpose for personal protective equipment (PPE) is to shield the individual in the event of a release of vapor, a spill or other incident. PPE is not a substitute for safe work practices. **Eye protection must be used during handling of any quantity of HF.** The following eye protection will be used:

Chemical safety goggles and full face shields are required. These are available in the lab at the chemical hood.



Thick Neoprene or Nitrile gloves or other HF-resistant gloves should be worn. HF burns around the fingernails are extremely painful, difficult to treat, and may require surgical removal of the nail.

It is also required that an acid resistant suit or apron be used since some clothing can absorb HF solution and maintain it close to the skin.

The following gloves/apron must be worn when handling HF in this laboratory:



II. Use Procedures:

A. Never use Hydrofluoric Acid when working alone after hours. Hydrofluoric Acid may be used when working alone during normal working hours provided knowledgeable laboratory personnel have been alerted and at least one is in the general vicinity to provide assistance if necessary. The LS/PI must be notified prior to any unaccompanied use of HF.

B. All lab personnel, not just those who will be using Hydrofluoric Acid, must be informed of the dangers of this chemical and the emergency procedures necessary in case of an accident. A sign should be posted to alert people that work with Hydrofluoric Acid is in progress.

C. All persons who use Hydrofluoric Acid must be made aware of its properties and trained in proper procedures for use and disposal. The LS/PI is responsible for providing this training.

D. Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) must have these emergency procedures on hand as well as the appropriate MSDS.

E. Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) must have an operational safety shower and eye wash in their laboratory. Before beginning any procedure involving Hydrofluoric Acid, make sure the access to the emergency shower and eyewash is unobstructed.

F. Undergraduate students should never be given the task of mixing Hydrofluoric Acid solutions. Only experienced persons familiar with its properties should handle the concentrated acid. The LS/PI is responsible for ensuring appropriately trained individuals mix hydrofluoric acid solutions.

G. A small supply of appropriate neutralizer for spills should be kept near the fume hood where the work will be conducted. If a small quantity (100 ml or less) of dilute Hydrofluoric Acid solution is spilled, clean it up by absorbing spilled material with the supplies in the Chemical Spill Kit, and apply neutralizer to decontaminate surfaces. In some instances, powdered calcium carbonate or calcium hydroxide may be used to neutralize spilled material. If a larger amount is spilled, or if the acid is concentrated, contain the spill as best as you can using supplies in the Chemical Spill Kit, evacuate the area, and call 911. Avoid exposure to the vapors.

H. Dispose of unwanted hydrofluoric acid or spill cleanup materials by submitting online waste pickup requests to: <http://www.orcbs.msu.edu>

- I. When working with Hydrofluoric Acid or concentrated HF solutions (> 1%):
1. Work in a fume hood with the sash as low as possible.
 2. Wear PPE as defined above.
 3. Wear a long -sleeved, buttoned lab coat, pants or long skirt, and closed- toe shoes.
 4. Wear thick Neoprene or Nitrile gloves or HF-resistant gloves.
 5. The LS/PI must be notified before any work with hydrofluoric acid occurs outside the chemical fume hood.
- J. Any exposure to Hydrofluoric Acid must be medically evaluated.

Hydrofluoric Acid Exposure Kit:

Before beginning work involving HF an exposure kit should be available and located in the laboratory area. Kit is located next to the eyewash at the main lab door.

The exposure kit should contain the following items:

- A. Container (tube) of 2.5% calcium gluconate gel. This gel is available from several suppliers.
The gel must be inspected at least monthly to ensure that it is available and has not reached the expiration date. If the gel has exceeded its shelf life or has been opened (i.e., used), a new tube must be purchased and the old container discarded.
- B. Two pairs of thick Neoprene or Nitrile gloves.
- C. University Chemical Response Kit
- D. Copy of the se procedure s and MSDS to provide to emergency response personnel.
- E. Calcium Carbonate (antacid tablets).

IV. Emergency Response Procedures:

A. Skin Exposure:

1. Move the victim immediately under an emergency shower or other water source and flush the affected area with large amounts of cool running water for at least 5 minutes. Clothing, shoes and jewelry should be removed while the water is flowing on to the victim.
Goggles should be removed last while the victim is facing the water flow. Colleagues must be EXTREMELY CAREFUL not to become contaminated while assisting the victim.
Thick Neoprene or Nitrile must be worn.
2. While the victim is being rinsed with water, call 911 and inform the emergency dispatcher of the exposure and request emergency transport. Ensure emergency responders and treating physicians are aware of the nature of the chemical exposure. Provide a copy of the MSDS to emergency responders.

3. After the affected area is flushed with copious amounts of water for at least five minute, apply 2.5% calcium gluconate gel according to this procedure. Massage gel into affected areas. Flush skin surfaces with water f or at least 15 minute s if calcium gluconate gel is not available. In order to prevent cross contamination, the victim should self-apply the calcium gluconate gel. If the victim is unable to self-apply, anyone present can apply the gel after first putting on thick neoprene or nitrile gloves. Do not use latex gloves because they are not an effective barrier against HF. Note the time when the calcium gluconate gel was first applied to the contaminated skin and provide this information to the emergency responders. Re-apply gel every 15 minutes until medical assistance arrives.
4. After the emergency responders arrive they will call the Emergency Room doctor for instructions and may administer the calcium carbonate tab lets (antacid tab lets) in the Spill Exposure Kit.

B. Eye Exposure:

1. Immediately flush eyes for at least 5 minutes with copious cool flowing water. Call 911, inform the emergency dispatcher of the exposure and request emergency transport. The victim should then be transported to a medical facility. MEDICAL PERSONNAL may apply a sterile 1% calcium gluconate solution to the victim's eyes after irrigation.
2. Ensure emergency responders and treating physicians are aware of the nature of the chemical exposure. Provide a copy of the MSDS to emergency responders.

C. Inhalation:

If a large volume of Hydrofluoric Acid gas is inhaled:

1. Immediately remove the victim to clean air. Call 911, inform the emergency dispatcher of the exposure and request emergency transport.
2. Ensure emergency responders and treating physicians are aware of the nature of the chemical exposure. Provide a copy of the MSDS to emergency responders.
3. 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.

Emergency Contact Numbers:

911 -- Emergency dispatch – Info them this is a HF chemical burn

355-2221 -- MSU Department of Public Safety

355-0153 -- Office of Radiation, Chemical & Biological Safety

355-5066 -- Electrical and Computer Engineering Dept Office

HF First Aid Report Form

This form is to be taken with the victim to the emergency room.

Employee Information:

Last Name: _____ First Name: _____

Employing Department: _____

Building/Room (Location): _____

Supervisor's Name: _____

Contact Phone Number: _____

Exposure Information:

Date of Incident: _____ Time of Incident: _____

Type of Exposure: ☐ Skin
☐ Eye
☐ Ingestion
☐ Inhalation

Injury Description: _____

First Aid Information:

Person Administering First Aid: _____

Contact phone Number: _____

Time of Treatment: _____

First Aid Measures taken: _____

Hydrofluoric Acid

Caution!

To Triage Nurse

This person was exposed to Hydrofluoric Acid!

Do not treat as a simple chemical burn!

The patient should be treated as
CTAS 2.

To Treating Nurse/Physician

Protect yourself and your staff!

Do not touch the victim with your bare hands!

Do not use regular gloves!

HYDROFLUORIC ACID (HF)

General Info

- HF is a very toxic and corrosive acid
- HF quickly penetrates tissues resulting in burns that require specialized treatment
- Cardiac symptoms can be delayed up to 24 hours after skin exposures
- Exposure of less than 10% of the body to HF can be fatal
- In high concentration can lead to systemic toxicity
- Can cause hypocalcemia, cardiac arrhythmias, metabolic imbalances, pulmonary edema
- Patient requires ECG and cardiac monitor

Caution: Wear nitrile gloves when touching the patient or removing their clothing!