

## Introduction

Hydrofluoric acid (HF) has a number of chemical, physical, and toxicological properties, which make handling this material especially 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.

## Uses

Concentrated hydrofluoric acid is used in the fabrication of electronic components, to etch glass and in the manufacture of semiconductors. Hydrofluoric acid gel is commonly used to etch all ceramic dental restorations to improve bonding. Because of its ability to dissolve oxides, HF is useful for dissolving rock samples prior to analysis. Dilute hydrofluoric acid solutions are used in some biological staining procedures.

## Chemical Properties

Hydrofluoric acid 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, Teflon, wax, lead or platinum containers.

## Toxicological Properties

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.

HF penetrates skin quickly and then corrodes soft tissue and bones. The fluoride ions bind to calcium in the body causing calcium deficiency. The calcium deficiency interferes with nerve function, so chemical burns may not be painful initially.

**If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.**

## Working with HF

### Engineering Controls

- HF should be used in a fume hood with the sash as low as possible to prevent vapor escape and to provide a physical barrier.
- Local ventilation should always be used when working with HF. The ACGIH ceiling limit and OSHA TWA for HF is 3 PPM.

### Work Practices

- **Never work alone with HF**, there must always be an additional person present with training in HF emergency procedures.
- Before beginning work ensure that access to the safety shower and emergency eyewash are not blocked and that they have been tested recently.
- A phone must be present in any lab where HF is being used.
- In order to warn and protect others from the hazard of HF, a warning sign indicating the use of HF should be posted.
- When diluting solutions ALWAYS add the acid to the water, NEVER add water to acid.
- A small amount of calcium carbonate or calcium hydroxide should be kept near the fume hood for use in the event of a HF spill.
- Containers of HF must not be left open in the fume hood, the vapors will etch the glass.

## PPE

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 in the form of safety glasses or goggles and a face shield should be used.
- Stanzoil Neoprene or Stanzoil Nitrile (22mil) gloves or other HF resistant gloves should be worn.
  - Inspect gloves prior to each use.
  - Remove immediately if contact with HF occurs.
  - Use proper glove removal technique (keep bare hands away from the outer surface of the gloves).
  - Dispose of gloves as hazardous waste.
  - Wash hands thoroughly with warm water and soap immediately after glove removal.
- It is also recommended that an acid resistant suit or apron be used.
  - Some clothing is able to absorb HF and will keep it close to the skin.
- Long pants and rubber or leather closed-toe shoes should be worn.

Avoid contact with skin, eyes, and clothes. Wash hands thoroughly after handling HF and before leaving the lab.

## HF Storage and Transport

- Store HF in original container or plastic bottles (polypropylene or polyethylene), NEVER IN GLASS.
- Store in a corrosive/acid storage cabinet within secondary containment (Nalgene/polypropylene tray or tub)
- Store on a shelf below eye level.
- Ensure the lid is tightly closed at all times.
- Do not store with oxides, organic chemicals, bases, or metals
- Anytime the bottle is being moved it must be in a plastic secondary container.

## HF Waste

Any waste that involves HF must be placed in a chemically compatible container that is clearly labeled with a Hydrofluoric Acid warning sign, in addition to all other required waste labels.

Gloves that come into contact with HF must be disposed of along with other HF waste and must not be placed into normal laboratory garbage.

## HF Exposure Kit

Before beginning work involving HF, an exposure kit must be available and located in the laboratory area. The exposure kit must contain:

1. Container of calcium gluconate gel
  - This gel must be inspected before each use of HF, or at least monthly, to ensure the gel has not been removed or reached the expiration date. If a tube of the gel has been opened, a new container must be purchased and the old container discarded. No work with HF can be done with an expired tube of calcium gluconate gel.
2. Two pairs of Stanzoil Neoprene or Stanzoil Nitrile (22mil) gloves
3. Heavy-duty polyethylene bag to be used for HF contaminated items
4. "HF Contaminated Waste" label
5. Copy of these procedures and the SDS to take to the emergency room
6. Calcium Carbonate (antacid tablets)

## Emergency Response Procedures

HF is very toxic and exposure can be fatal if not treated immediately. HF is absorbed quickly into the skin but damage and symptoms can occur up to days later.

**Any person exposed to HF must have immediate first aid followed by immediate medical treatment**

**Bring a copy of the SDS to the emergency room when going for treatment**

Anyone aiding someone who has come into contact with HF needs to be careful not to contaminate themselves.

Make sure to fill out an Incident Report with EH&S as soon as possible after the emergency.

## Skin Contact

**Use the following instructions with the HF Exposure Kit:**

1. Immediately flush affected area with water for 5 minutes
  - a. While in the water, remove all clothing, shoes, jewelry
  - b. Remove goggles: close eyes, face water flow, pull goggles over head
2. Have someone call **911**, tell them:
  - a. There is a person who was exposed to Hydrofluoric Acid
  - b. The victim is in location: \_\_\_\_\_
  - c. Please send paramedics and an ambulance
3. Using a gloved hand, apply calcium gluconate gel to affected area
  - a. Note the time that the gel was first applied so that information can be given to the paramedics.
4. Continue to reapply gel every 15 minutes until paramedics arrive.
5. When paramedics arrive tell them what decontamination steps have been taken:
  - a. How long the person was in the water
  - b. When the gel was administered
6. When paramedics arrive they should contact the Emergency Room for instructions and approval to administer the calcium carbonate tablets (antacid tablets) found in the HF Exposure Kit.
7. The responding person or assisting lab personnel must escort the victim to the hospital
  - a. Bring a copy of the SDS and these emergency procedures to the hospital

**If HF Exposure Kit is not available:**

1. **Contact 911** for immediate transport to emergency room, tell them:
  - a. There is a person who was exposed to Hydrofluoric Acid
  - b. The victim is in location: \_\_\_\_\_
  - c. Please send paramedics and an ambulance
2. Flush area with water for at least 15 minutes or until emergency personnel arrive.
  - a. Remove all clothing, shoes, and jewelry while in the water
  - b. Remove goggles: close eyes, face water flow, pull goggles over head
3. When paramedics arrive tell them what decontamination steps have been taken:
  - a. How long the person was in the water
4. Inform paramedics that no HF Exposure Kit was available so no calcium gluconate gel has been applied.
5. The responding person or assisting lab personnel must escort the victim to the hospital
  - a. Bring a copy of the SDS and these emergency procedures to the hospital

## Eye Contact

**If only one eye is affected, take care not to flush HF from the contaminate eye into the other eye.**

1. Immediately flush eyes with water for 5 minutes



- a. If a sterile 1% calcium gluconate solution is available, flush eyes with the solution after 5 minutes of water
- b. If no solution is available continue flushing eyes with water until paramedics have arrived
2. **Call 911** for immediate transport to the emergency room, tell them:
  - a. There is a person who's eyes were exposed to Hydrofluoric Acid
  - b. The victim is in location: \_\_\_\_\_
  - c. Please send paramedics and an ambulance
3. When paramedics arrive tell them what decontamination steps have been taken:
  - a. How long eyes were flushed with water for.
  - b. If calcium gluconate solution was used to flush eyes.
4. When paramedics arrive they should contact the Emergency Room for instructions and approval to administer the calcium carbonate tablets (antacid tablets) found in the HF Exposure Kit.
5. The responding person or assisting lab personnel must escort the victim to the hospital
  - a. Bring a copy of the SDS and these emergency procedures to the hospital
6. If possible, provide continuous irrigation to the eye(s) during emergency transport

### Inhalation

Inhalation of HF fumes may cause swelling in the respiratory tract up to 24 hours after exposure. Persons who have inhaled HF vapors may need prophylactic oxygen treatment and must be seen by a physician as soon as possible.

In the event of inhalation:

1. Immediately move victim to fresh air
2. **Call 911**, tell them:
  - a. There is a person who inhaled Hydrofluoric Acid
  - b. The victim is in location: \_\_\_\_\_
  - c. Please send paramedics and an ambulance
3. Cordon off the area, if HF vapors are still present
4. When paramedics arrive they should contact the Emergency Room for instructions and approval to administer the calcium carbonate tablets (antacid tablets) found in the HF Exposure Kit.
5. The responding person or assisting lab member must escort the victim to the hospital
  - a. Bring a copy of the SDS and these emergency procedures to the hospital.

### Ingestion

Do not induce vomiting

1. Rinse mouth with cold water
2. If victim is conscious, have them drink lots of water to dilute the acid
  - a. Note the time that water is ingested
3. **Call 911**, tell them:
  - a. There is a person who ingested Hydrofluoric Acid
  - b. The victim is in location: \_\_\_\_\_
  - c. Please send paramedics and an ambulance
4. When paramedics arrive they should contact the Emergency Room for instructions and approval to administer the calcium carbonate tablets (antacid tablets) found in the HF Exposure Kit.
5. Inform the paramedics of any decontamination steps performed (e.g. rinsed mouth, gave \_\_\_ amount of water to drink)

### Spills

Immediately call EH&S (6496 or 6455) to report any HF spill that is:

- Life threatening
- Greater than 30mLs
- Will take longer than 15 minutes to clean up

**Normal laboratory spill kits cannot be used for HF clean-up. Many typical neutralization agents produce hazardous gas or otherwise react with HF.**

If a small quantity (less than 30mL) of dilute (<1%) hydrofluoric acid solution is spilled:

1. Apply powdered calcium carbonate or calcium hydroxide to neutralize the spill.
  - a. Or use a commercial Hydrofluoric Acid spill kit
2. Carefully collect the powder/acid mixture with a disposable scoop and place in appropriate container for disposal
3. Dispose of contaminated PPE in same container
4. Close container, with clean gloves on, and label with HF warning signs.
5. Wash the spill site with a sodium bicarbonate solution.
6. Contact EH&S for removal of waste.

If a large volume, or concentrated, hydrofluoric acid is spilled:

- DO NOT attempt to clean up the spill
- Isolate the area to prevent spread of contamination
  - Close doors and post warning signs and/or personnel to prevent entry
- Alert personnel in the immediate area to evacuate
- Attend to any injuries
- Contact EH&S and **911**

**Remember: ANY exposure to Hydrofluoric acid must be medically evaluated.**