

University of Rochester Hydrofluoric Acid Safe Handling Guidelines

Purpose:

This safe handling guideline provides information/awareness of the hazards of HF, ways to protect you against the hazards of HF, and emergency procedures to follow for exposures/contamination.

Some hydrofluoric acid case studies include:

- An individual was exposed to 70% HF to 25% of total body surface area. The victim developed second degree burns. The exposure lowered the ionized serum calcium level to 1.7 milligrams per deciliter (mg/dL) (normal range is 4 to 4.8 mg/dL).
- An individual had burns over 8% of his body from HF exposure. A victim died from cardiac arrhythmia and depletion of ionized calcium.
- An individual died after exposure to 70% HF over 2.5 % total body surface. The serum calcium level was 2.2 mg/dL.
- An individual had HF thrown onto her face. She died from chemical burns of the skin and lungs and pulmonary edema.
- Two individuals were exposed to 70% HF onto their faces, chests, arms and legs. Although taking first aid immediately by removing clothing and taking a cold shower, they died. Neither of the individuals wore protective equipment.

These cases show the severity of HF exposure and the need to use personal protective equipment whenever handling hydrofluoric acid.

Scope:

Hydrofluoric acid (HF) is an extremely corrosive acid used in many laboratory processes (sample digestion, surface cleaning, etching, and biological staining). HF is significantly more hazardous than many other acids. This safe handling guideline provides information/awareness of the hazards of HF, ways to protect yourself against the hazards, and emergency procedures to follow for exposures/contamination. Potential health hazards can vary depending upon the concentration, mode, and duration of exposure. This guideline must be included in the standard operating procedure notebook for those labs using HF.

Guidelines:

Eye and skin exposure

HF is very corrosive and readily destroys tissue. Eye contamination/exposure may result in blindness or permanent eye damage. HF readily penetrates human skin, allowing it to penetrate quickly through soft tissue and destroy both soft tissues and decalcify the underlining bone. Skin contamination to 50% or greater HF solutions can result in immediate serious and painful destruction of tissue. Chemical burns are typically very painful and slow to heal. Once HF penetrates the skin, systemic fluoride poisoning may result that could be fatal. Lower concentrations of HF may not produce pain or burning sensations until hours after the exposure. **All skin, eye, or tissue contact with HF solutions should receive immediate first aid as well as medical evaluation/treatment, even if the contamination appears minor.**

Inhalation of HF vapor

Inhalation of HF vapors can seriously damage the lungs. Delayed health effects including fatal pulmonary edema (flooding of the lungs with body fluids) could occur hours after the initial exposure. The OSHA Permissible Exposure Limits to airborne concentrations of HF is 3 parts per million (ppm) (as Fluorine) over an 8-hour day. Airborne concentrations of 10-15 ppm will irritate the eyes, skin, and respiratory tract. Even brief exposures of HF above 50 ppm may be fatal.

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Chronic HF exposure

Long-term or chronic exposure/contamination to HF may result in fluorosis. This health problem is characterized by weight loss, anemia, bone embrittlement, and general ill health.

INFORMATION AND TRAINING

All employees handling HF must receive documented training from the PI or his/her representative on the hazards of HF and what to do in the event of an exposure or spill. Training records are to be retained in the lab. A Safety Data Sheet (SDS) on HF must be kept in the immediate work area.

ENGINEERING CONTROLS AND PERSONAL PROTECTION

Ventilation

HF must be used with adequate ventilation to minimize inhalation of vapor. Concentrations greater than 10% of the concentrated material must be handled inside a chemical fume hood. The fume hood needs to have a current calibration sticker (within 1 year). Should the fume hood appear not to be functioning properly, contact Facilities (x34567) immediately.

Eye Protection

Because HF is highly corrosive, safety glasses with side shields **do not** provide adequate eye protection. Personnel are to use non-vented chemical splash goggles and a face shield when handling concentrated HF.

Body Protection

Personnel are to wear a lab coat with a chemical splash apron made out of Viton, neoprene or natural rubber when handling concentrated HF. Prohibited clothing includes shorts, skirts, and open-toed shoes/sandals when handling HF. The chemical splash aprons should be rinsed off or wiped down with wet paper towels after use. Dispose of these paper towels in the lab's general trash bag.

Gloves

Personnel need to consult a manufacturer's glove selection guide to determine the types of gloves needed for the HF work planned. The EHS Laboratory Safety Unit can assist you in the appropriate glove selection. As a minimum, medium weight Viton, nitrile, or natural rubber gloves are recommended. Personnel can elect to wear a second pair of nitrile gloves under the heavier-duty gloves for additional protection. Because these protective gloves are intended to supply splash or drip protection, never submerge fingers of gloved hands into these solutions. Gloves not contaminated with HF may be disposed of as regular trash. Gloves contaminated with HF need to be removed immediately, hands examined for possible exposure, and hands washed. Contaminated gloves must be disposed of as hazardous waste through the Environmental Compliance/Hazardous Waste Unit (275-2056).

EMERGENCY PROCEDURES

The SDS for HF, this guideline, the "Hydrofluoric Acid Emergency Procedures for HF" document and the laboratory's Standard Operating Procedure for the handling of HF must be kept in the immediate work area. These documents provide specific information on first aid measures and medical treatment needed for contamination/exposures. **It is imperative that any person who has been exposed to HF seeks medical advice/treatment even if first aid administration of calcium gluconate gel has occurred.**

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Calcium Gluconate Gel

Calcium gluconate gel is a topical antidote agent for **first aid treatment** of HF skin exposure. **It should never be considered a substitute for medical evaluation and treatment of HF exposures.** Calcium gluconate combines with HF to form insoluble calcium fluoride. This reaction prevents calcium from being extracted from tissues and bones.

A tube of calcium gluconate gel should be maintained in locations where HF is used. **Calcium gluconate has a limited shelf life and should be stored in a refrigerator. A new supply needs to be ordered and received prior to the expiration date on the container.**

When the gel is applied, utilize disposable gloves to apply the gel to the affected area while minimizing exposure to non-affected skin. **After applying calcium gluconate, seek medical attention immediately.**

First aid and medical treatments:

Eyewash and Shower

Since HF is corrosive and rapidly damages tissue, OSHA requires an eyewash station in the immediate work location (same room). The eyewash needs to be flushed weekly to ensure proper operation of the unit and to maintain clean water in the line. A log is to be maintained to document the flushing occurred. The eyewash stations needs to be accessible at all times. OSHA requires a safety shower be within 10 seconds of unobstructed travel distance (about 75-100 feet) of locations using HF. Safety showers are periodically tested/flushed by Facilities to ensure proper operation.

Eye exposure

Personnel with an eye exposure need to use the eyewash station immediately and irrigate the eyes for at least 15 minutes. Do not apply calcium gluconate gel to eyes. Have a co-worker call for medical assistance (Public Safety, ext. 13) while flushing occurs. **In all cases of eye exposure, seek prompt medical attention.**

Skin Exposure

For skin exposures, immediately remove any contaminated clothing and start rinsing the affected body part with water for 15 minutes. Have a co-worker call for medical assistance (call Public Safety, x13) while the rinsing is occurring. If calcium gluconate gel is readily available, apply, using a glove, to the affected area quickly to limit the migration and penetration of the fluoride ion. **Should medical attention take more than 15 minutes, reapply and massage the calcium gluconate gel into affected area of skin every 15 minutes until medical attention is obtained.**

Contaminated clothing needs to be packaged and disposed of as hazardous waste through the Environmental Compliance/Hazardous Waste Unit (275-2056). Handle contaminated clothing with gloves. [Remove any valuables from the clothing before disposing.]

Inhalation

Move victim to fresh air. **Seek prompt medical attention.**

Ingestion

Do not induce vomiting. Drink large amounts of water or, if available, several glasses of milk or milk of magnesia to dilute any ingested HF. **Seek prompt medical attention.**

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SAFE STORAGE AND HANDLING OF HF

Safe Work Practices

Do not eat, smoke, or drink where HF is used/stored. The Laboratory Safety Unit recommends that 2 people be present when concentrated HF solutions are used. After any glove removal, hands should be checked for possible exposure and then washed.

HF Spills

Small spills of HF inside a chemical fume hood, or spills of less than 50 ml of concentrated HF (or equivalent) outside of fume hoods, can be cleaned up by laboratory staff provided they have been trained and understand the hazards of HF, have the necessary supplies, and have adequate staff to handle the spill.

Spilled greater than 50 ml of concentrated HF (or equivalent) outside a chemical hood requires the evacuation of the immediate area. Close the door(s) and call Public Safety (x13) and request the University Spill Response Team. Post an employee at the door (outside of the location) to keep personnel out of the space until the spill team arrives.

The Laboratory Safety Unit recommends lime (sodium carbonate) be used to absorb HF. Sodium bicarbonate or other approved absorbent specified for HF can be used for clean up. Never use products such as commercially prepared organic spill kits because the HF can react with the absorbent materials releasing silicon tetrafluoride, a toxic gas.

Any collected waste needs to be placed into a heavy-duty plastic (polyethylene or Teflon) bucket with a sealable top. A Hazardous Waste Tag needs to be placed on the container. Contact the Environmental Compliance/Hazardous Waste Unit at 275-2056 for a pick-up.

Storage/Mixing

All HF solutions are to be labeled and stored in chemically compatible containers (e.g., Teflon or polyethylene) only. Do not store HF near or with incompatible chemicals such as ammonia or other alkaline materials. HF solutions must never be stored at or above eye/chest level at workbenches, otherwise potential eye or other exposures could occur should the bottle be dropped or fall. All solution preparation is to utilize Teflon or polyethylene containers.

Waste

HF waste must be placed in a chemically compatible container (polyethylene or Teflon) having a sealed lid, properly labeled, and disposed of through the Environmental Compliance/Hazardous Waste Management Unit (275-2056).

HAZARDS ASSOCIATED WITH OTHER FLUORINE COMPOUNDS

Many fluorine containing chemicals may react with water or acids to produce HF. The Laboratory Safety Unit recommends personnel review the SDS of any fluoride compounds they have to minimize the risk of creating a HF hazard.

Administration:

The Laboratory Safety Unit can assist personnel on the hazards of HF, its storage, handling, and cleanup procedures. If assistance is needed, or if you have questions about HF, call 275-3241.

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