

Guidelines for the Safe Use of Hydrofluoric Acid (Draft)

Hydrofluoric acid (HF) is an extremely corrosive acid used for many purposes including mineral digestion, surface cleaning, etching, and biological staining. HF's unique properties make it significantly more hazardous than many other acids. This document discusses the health and safety hazards of HF and how to protect you from them. Also included are emergency procedures for dealing with HF exposures.

Health Hazards

The health hazards of HF are dependent upon the concentration and type of exposure.

1. HF is corrosive and readily destroys tissue. Exposure of the eyes to HF may result in blindness or permanent eye damage. HF readily penetrates human skin, allowing it to destroy and decalcify soft tissues and bone. Skin exposure to concentrated HF (approximately 50% or greater) immediately results in serious and painful destruction of tissue. Not only can skin contact cause burns, but systemic fluoride poisoning may also result.
2. One of HF's most insidious properties is that skin contact at lower concentrations (typically < 20%) may not produce pain or burning sensations until hours after the exposure. Because of the ability of HF to produce severe, delayed tissue damage without producing pain, all skin, eye, or tissue contact with HF should receive immediate first aid and medical evaluation, even if the exposure appears minor or no pain is felt.
3. Inhalation of HF vapor can seriously damage the lungs. Delayed reactions up to and including fatal pulmonary edema (flooding of the lungs with body fluids) may not be apparent for hours after the initial exposure. OSHA limits employees' exposure to airborne concentrations of HF to an average of 3 parts per million (ppm) over an 8-hour workday. Airborne concentrations of 10 to 15 ppm will irritate the eyes, skin, and respiratory tract. Thirty ppm is considered immediately dangerous to life and health and may have irreversible health effects. At airborne concentrations above 50 ppm, even brief exposure may be fatal. Long-term or chronic exposure to HF may result in fluorosis; a syndrome characterized by weight loss, bone embrittlement, anemia, and general ill health.

Safety Precautions for HF Use

1. Employee Information and Training- HF is a colorless liquid with a strong irritating odor at low concentrations (3 ppm). Employees who handle HF must receive training on the hazards of HF and what to do in the event of an exposure or a spill. A Material Safety Data Sheet (MSDS) on HF should always be kept in the immediate work area where HF is used. The MSDS, together with this Fact Sheet, can be used for initially

training employees on the hazards of HF. EH&S is also available for providing assistance with training.

2. Lab Ventilation - HF at Concentrations greater than 5% should always be handled inside a certified chemical fume hood to minimize inhalation of vapors.
3. Eye Protection - Chemical goggles together with a face shield are recommended when handling concentrated HF. Due to HF's high corrosivity, safety glasses with side shields may not provide adequate eye protection.
4. Body Protection - Wear a lab coat with a chemical splash apron made out of natural rubber, neoprene, or viton. Never wear shorts, skirts above the knee or open-toed shoes when handling HF or other corrosive chemicals.
5. Gloves- Medium or heavyweight viton, nitrile, or natural rubber gloves are worn when working with HF. Always consult the manufacturer's glove selection guide when selecting a glove for HF. If you have any questions about which glove to choose, contact EH&S. A second pair of nitrile exam gloves should be worn under the gloves for protection against leaks. If gloves become contaminated with HF, remove them immediately, thoroughly wash your hands, and check your hands for any sign of contamination. Contaminated gloves must be disposed of as HF waste (see "Spill, Storage, and Waste Issues" section).
6. Eyewash/Emergency Shower- Since HF is corrosive and rapidly damages tissue, EH&S recommends a combination eyewash/shower to be nearby and accessible. The eyewash must be tested weekly to ensure it will operate when needed. The combination eyewash/ shower should be used to rinse the exposed area for at least 5 minutes, and then treatment of skin with calcium gluconate gel should be initiated.
7. Response to Skin Exposure-Calcium gluconate gel is a topical antidote for HF skin exposure. It works by combining with HF to form insoluble calcium fluoride, thus preventing the extraction of calcium from tissues and bones. Always keep calcium gluconate gel nearby whenever you're working with HF. Calcium gluconate can be ordered through the Chemistry Department Store Room.

Note: Calcium gluconate has a limited shelf life. It should be stored in a refrigerator and replaced after its labeled expiration date. Use nitrile exam gloves to apply calcium gluconate gel. Even after applying calcium gluconate, it is essential that a medical evaluation be made.

Spill, Storage and Waste Issues

1. Waste HF should be placed in a chemically compatible container with a sealed lid and clearly labeled using the University's hazardous waste label. Contact EH&S if you need additional labels or have any questions regarding the disposal of HF wastes.
2. Many chemicals containing fluorine, such as ammonium fluoride, sodium fluoride, sulfur tetrafluoride, and ammonium bi-fluoride, may react with acid or water to produce HF. Review the MSDS of all fluoride compounds carefully for safety precautions to reduce the risk of creating a HF hazard. If the manner in which the fluorine compound is used can create HF, follow the precautions for HF and keep topical antidote on hand.
3. EH&S is available to help train staff or students on the hazards and use of HF. EH&S can evaluate your chemical fume hood or HF use in your lab. Please call EH&S at 412 624-9505.
4. Safe Work Practices- If possible, avoid working alone when you're using HF. Do not eat, smoke, or drink where HF is handled, since the chemical can be swallowed. Always wash hands thoroughly after handling HF.
5. HF Spills- If HF is spilled outside a chemical fume hood, evacuate the area. Close the doors. Post the area with a sign to prevent others from entering. Call 811 on the Pittsburgh Campus. If the incident occurs during regular work hours (Monday–Friday, 8 a.m. to 5 p.m.), also call EH&S at 412-624-9505. Small spills of HF inside a chemical fume hood can be cleaned up by laboratory staff if they have the correct equipment, understand the hazards, and know how to clean up the spill safely and dispose of the waste properly. Lime soda, ash, sodium bicarbonate, or a spill absorbent specified for HF should be used for clean up. Organic spill kits that contain Floor-dri, kitty litter, or sand should not be used because HF can react with silica to produce silicon tetrafluoride, a toxic gas.
6. Storage- Store all HF and HF waste in labeled chemically compatible containers (e.g., polyethylene or Teflon). Glass, metal, and ceramic containers are not compatible with HF. HF should never be stored with incompatible chemicals such as ammonia or other alkaline materials. Always place HF on a low protected shelf or other location where it will not be accidentally spilled or knocked over.

Emergency Procedures for HF Exposures

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

Skin contact

1. Immediately proceed to the nearest eyewash/shower and wash affected area for a minimum of 5 minutes.
2. While washing the affected area, have someone call 811 for emergency medical assistance.
3. Remove all contaminated clothing while in the shower.
4. Massage calcium gluconate gel into the affected area. Be sure to wear a nitrile glove on the hand spreading the gel. If calcium gluconate gel is not available, wash affected area for at least 15 minutes or until emergency medical assistance arrives.
5. Reapply calcium gluconate gel and massage it into affected area every 15 minutes until assistance arrives.
6. Proceed to physician for appropriate follow-up and/or treatment.

Eye contact

1. Immediately proceed to the nearest eyewash station.
2. Wash eyes with water for at least 15 minutes while holding eyelids open.
3. Do not apply calcium gluconate gel to eyes.
4. While washing eyes, have someone call 811 for emergency assistance.
5. Proceed to emergency treatment center for appropriate follow-up.

Inhalation

1. Leave the area where vapors are present
2. Close door to room.
3. Report condition to supervisor and/or co-workers
4. Call 811 on Pittsburgh Campus for emergency medical assistance.