Carnegie Mellon University Environmental Health & Safety FIRE | LAB | WORK	**Environmental Health and Safety Standard Operating Procedure (SOP) - For the use of Hydrofluoric Acid (HF)**
Date of Issuance:	**Revision Date:** 3/10/2021
Revision Number: 1	**Prepared by:** EHS

Please complete the Hydrofluoric Acid Safety Training and fill out this SOP prior to use Hydrofluoric acid (HF) in the laboratory. All HF users should completed this document and upload to the users BioRAFT account. This document discusses the health and safety hazards of HF and how to protect you from them along with the emergency procedures for dealing with HF exposures. If you need assistance in completing the HF Training, or this SOP, please contact safety@andrew.cmu.edu.

1. Contact Information

Name of Principle Investigator & Andrew ID:

Name of the Department:

Name of Group Safety Coordinator & Andrew ID:

Location (Building and Room or Lab Number):

Hydrofluoric Acid, Percentage:

Name of HF Users and Andrew ID:

2. Introduction

Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties, which make it especially hazardous to handle. Hydrofluoric acid is an extremely corrosive acid used for many purposes including mineral digestion, surface cleaning, etching, and biological staining. Both Anhydrous Hydrofluoric acid and aqueous solutions are clear, colorless, and highly corrosive liquids. HF's unique properties, including systemic toxicity, make it significantly more hazardous than many other acids. All forms, including the solution or the vapor can cause severe burns to tissue and cause serious systemic effects. If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.

3. Hazard Overview

The primary hazard of HF is as a Health Hazard, it can readily absorb through the skin and signs or symptoms are dependent on the concentration. HF can destroy and decalcify soft tissue and bone, concentrations above 50% will burn immediately. One of HF's insidious properties is that concentrations lower than 20% may not produce immediate pain or burning. It is this delayed awareness of exposure that poses the most serious risk of HF. Exposure of the eyes of HF may result in blindness or permanent eye damage. Inhalation if HF vapor can

seriously damage the lungs, and may cause fatal pulmonary edema (lungs flooding with fluid). Again, the increased risk being that signs and symptoms may not be apparent for hours after the exposure. Chronic (long term exposure) of low concentrations to HF may cause fluorosis; syndrome characterized by weight loss, bone embrittlement, anemia, and general ill health.

4. Hazardous Material Description

Compound: Hydrofluoric acid
Synonyms: Hydrogen fluoride, fluoric acid, hydrofluoride, fluorine monohydride
CAS No: 7664-39-3
Mol. Formula: HF
Mol. Weight: 20.01
Boiling point: 68°F (20°C) at 760 mmHg
Specific gravity: 0.99 at 19°F
Vapor pressure: 400 mmHg (34°F)
Vapor density: 0.1 (air=1)
Description: Colorless gas or fuming liquid. Disagreeable, pungent odor at <1 ppm
Solubility: Miscible with water with release of heat
Flammability: Nonflammable
Concentrations: HF varies in aqueous phase concentrations

5. Working with Hydrofluoric Acid

a. **Training and Preparation**: All HF users must receive the training on hazards of HF and the steps, which need to be followed in the event of an exposure or a spill. EHS provide this training in class as well as online in BioRAFT. A Safety Data Sheet (SDS) on HF should always be available for workers. PI or Lab Manager should obtain a Hydrofluoric Acid First Aid Kit from EHS and complete this SOP. Lab also needs to ensure that all the users are properly trained for HF safety, review this SOP, and have a calcium gluconate gel in work area, before start working with HF. Please contact EHS for any assistance with training, First Aid Kit, SDS or this SOP.
b. **Safe Work Practices**: Never work alone with HF or after hours. Implement the Buddy System when using HF in the lab. Do not eat, drink or smoke where HF is handled, since the chemical can be swallowed. Be Aware of and Avoid Cross Contamination in the Lab. Always wash hands thoroughly after handling HF. EHS is available to help train staff or students on the hazards and use of HF.
c. **Engineering Controls**: HF in concentrations above 5% must be used in a chemical fume hood. HF as a compressed gas must be contained within a ventilated cabinet (NOTE: HF gas at any percentage is considered Highly Hazardous). Please contact EHS, if you need evaluation of the chemical fume hood for HF use in your lab.
d. **Administrative Controls**: Individual who use HF must complete the EHS training, as found on BioRAFT. In addition, they shall review and sign off on this SOP. If able, use a shield or at a minimum keep the fume hood sash as low as possible to protect from splashes. When feasible, minimize the concentration of HF that is to be used. A specific

use protocol should be outlined by the Lab PI, or Safety Coordinator. If one does not exist, contact EHS to assist with a Process Safety Review.

e. **Personal Protective Controls**:
When handling HF, the following PPE shall be worn:
   i. **Eye protection**: Goggles and/or a face shield are recommended when handling HF. Due to HF's high corrosivity, safety glasses with side shields may not provide adequate eye protection.
   ii. **Gloves**: Medium or heavy weight viton/nitrile/natural rubber gloves (recommend 22 mil) should be worn as the outer glove when working with HF (note: double gloving should be considered as a Best Practice). For higher concentrations (>5%), long chemical compatible gloves (12 inches) should be worn. If outer gloves become contaminated, they should be washed before removing. Remove gloves in a manner to prevent contamination of the inner glove. Thoroughly wash your hands, and check hands for any sign of contamination. Contaminated gloves must be disposed of as HF waste. Consult the glove manufacturer's chemical compatibility chart for best selection.
   iii. **Body protection**: Wear a lab coat with a chemical splash apron (NOTE: there should be no exposed skin when working with HF). Wear closed-toe shoes and long pants when working with HF.

f. **Storage and transport**: Glass containers should not be used to store or transfer HF, as HF reacts with glass. Ensure all HF containers are clearly labeled. Use chemically compatible secondary containers to store HF in the cabinet or to transport HF vials or bottles from one lab to another. Keep all HF containers closed and secured properly. Use proper PPEs, moving carts and precautions, while transporting HF.

6. Emergency Procedures (Spill and Exposure)

a. Eyewash/Emergency Shower: Since HF is corrosive and rapidly damages tissue, EHS 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.

b. Response to Skin Exposure: EHS provides a First Aid Kit to all users for exposure to HF. 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. Please note the expiration date of the calcium gluconate. Expired calcium gluconate should be replaced by contacting EHS.

7. Waste Management

All concentrations of HF must be collected according the Carnegie Mellon University Environmental Health & Safety Hazardous Waste. This includes, gloves, paper towels, absorbing pads and other spill cleanup materials. Glassware should be cleaned and

decontaminated, or it should be collected as hazardous waste. Hazardous waste containing HF should be stored in chemically compatible containers, eg. Polyethylene or Teflon (NO glass, metal or ceramic). Hazardous wastes containing HF should be segregated from incompatible wastes including wastes containing ammonia and alkaline materials. All waste containers must have a hazardous waste label during use and a hazardous waste certification tags for collection. HF and the concentration should be clearly indicated on the label and tag. Contact EHS if you need additional information or have any questions regarding the disposal of HF wastes.

8. Designated Use Area

HF shall be used in Designated Fume Hoods, marked with proper signage to warn others of the possible risk for contamination and exposure. Ensure that fume hood is working properly and have current certification (within last 12 months). Work areas should be cleaned and decontaminated routinely. Contact EHS when there is a known area of contamination needing cleaned.

9. HF Spills and Exposure

Please follow the EHS Hydrofluoric Acid Spill and Splash Guidelines and Procedures, available in your HF First-aid Kit. Contact EHS to report the accident/incident involving HF, for any HF spill cleanup or if you have any question or require more information regarding HF spill and exposure response. n!

10. Detailed Use

Please reference the Specific Use Protocol for the way/manner in which you will be using HF.
NOTE: this should come from your PI or Lab Safety Representative.

11. Revisions

Date	Documented Changes	Initials
3/10/2021	Updated Format and Accessibility Update	MAS