

**University of Saskatchewan  
Department of Mechanical Engineering  
Standard Operating Procedure # Mat0006**

**Procedure Title: Mixing and Using Etchants or solutions that Contain Hydrofluoric  
Acid (HF)**

**Minimum Review Requirements:    Annually**

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# Reference Only

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## 2. Introduction

This SOP provides the framework for using Hydrofluoric Acid (HF) in room 0C14 of the Engineering building, use of HF containing solutions is **not allowed outside of 0C14** or by personnel or students who have not been specifically authorized to handle HF. Using HF must be approved of **every time** it is being used even after you are trained. In addition to this SOP the University **Hydrofluoric Acid/Hydrogen Fluoride Emergency Protocol** and the **Guidelines in Case of a HF Exposure MUST** be read and understood prior to any HF usage. If other chemicals are being mixed with HF they may also have specific SOPs and their MSDS information must be understood prior to their usage.

All faculty supervisors of students working with HF must have read, understood and signed this and all other appropriate documents prior to the use of HF by their students.

**It is the responsibility of the Faculty Supervisors to ensure that all users of HF under their supervision/direction are competent in the use of the provided PPE and emergency response equipment (including the nebulizer and oxygen cylinder/regulator), as well as ensuring that the equipment is functional. This training will NOT be provided by the Departmental Assistant.**

All students wanting to use HF, must first submit a proposal outlining why it is necessary and what alternatives have been considered and the reason for their rejection.

## 3. Definition

SOP:	Standard Operating Procedure
MSDS:	Material Safety Data Sheet
WHMIS:	Workplace Hazardous Materials Information System
PPE:	Personal Protective Equipment
WSEP:	Workplace Safety and Environmental Protection
HF:	Hydrofluoric Acid

## 4. Personnel

Persons authorized to perform this SOP:

By signing this form I acknowledge that I have read and understand this SOP, as well as the applicable MSDS's and that I will conduct myself in accordance with this SOP and the general laboratory rules.

**NOTE: ALL SIGNATURES MUST BE PRESENT ON THE SOP LOCATED IN THE YELLOW BINDER IN ROOM 2C26 – Mechanical Engineering Materials Lab, digital copies of**



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**5. Safety**

- Pain associated with exposure to HF solutions (1-50%) may be delayed for 1-24 hours. If HF is not neutralized quickly and the fluoride ions are allowed to bond with tissue or bone, destruction of the tissue or bone can continue for days and result in **limb loss or death**.
- All exposures to HF, regardless of concentration should be evaluated by a medical professional.
- Fluoride ions (from HF) are both acutely and chronically toxic and may be **fatal** if absorbed.
- HF readily penetrates skin and damages underlying tissue.
- Fluoride ions can cause the destruction of soft tissues and decalcification of bones.
- Acute effects of HF include severe eye damage, extreme respiratory irritation, pulmonary endema, and may be fatal if inhaled.
- Skin, eye or lung exposure to concentrated (>50%) HF solutions will cause severe penetrating burns, and can lead to permanent damage, blindness or death.
- Low concentration HF solutions (<25%) can sometimes cause no immediate discomfort if spilled on skin, however after several hours they will start to burn.
- Exposure to less concentrated solutions of HF may have equally serious effects to those from high concentrations of HF, however symptoms can be delayed by up to 24 hours.
- Treat any exposure to HF or HF containing solutions the same, regardless of the presence or absence of immediate pain.
- HF solutions as weak as 1% HF can still rapidly penetrate the skin and cause severe damage to the underlying tissue.

**6. Procedure**

**PART A – MIXING AN ETCHANT**

**Stage 1: Setting Up**

1. Notify all persons in the area (i.e. the entire basement suite) that you will be working with HF acid.
2. Ensure that all persons in the area have read and understand the dangers of working near HF acid (they **MUST** have signed this SOP).

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3. Put sign on door of OC14 indicating that you are working with HF acid. Signs are in the HF use kit with the HF specific PPE.
4. Inspect PPE and verify all required materials are available.
5. Test eyewash station to verify its status.
6. Check emergency shower to ensure it has been inspected recently. If in doubt use a bucket to test the shower, **Do NOT use the shower without a catch bucket unless it is an emergency.**
7. Verify that Fume Hood is on and operational.
8. Label the waste disposal container.
9. Label the beakers or other containers which will sit for greater than 15 minutes with chemicals in them, masking tape labels are ok for these.
10. Review what to do in case of an accidental spill, both inside the fume hood and outside the fume hood.
11. Check the HF spill kit and confirm that the following are all present and NOT expired:
  - a. Safety Glasses or Goggles
  - b. Several Pairs of Neoprene or PVC gloves
  - c. 2-4 tubes of 2.5% Calcium gluconate Gel
  - d. 1 litre of 1% calcium gluconate irrigation solution
  - e. 1 package of Tums/Calcium carbonate
  - f. 1 portable O<sub>2</sub> cylinder
  - g. 1 Nebulizer
  - h. 500 ml of 2.5% calcium gluconate nebulizing solution
  - i. Pocket Mask to give rescue breathing
  - j. Eye irrigator
  - k. First Aid Shears – to remove contaminated clothing
  - l. University of Saskatchewan Hydrofluoric Acid/Hydrogen Fluoride Emergency Protocol
  - m. Guidelines in case of a Hydrogen Fluoride Exposure, Comite Technique Europeen du Fluor, 2<sup>nd</sup> Edition.
  - n. 1 Pair of Tongs (to pick up and HF containing solids use tongs and not your hands, even if gloved).
12. Put on PPE. **(For work with concentrated (10% or higher) HF you MUST double glove, first disposable Nitrile then reusable Neoprene).** This includes a lab coat, apron, gloves, see the required materials list for the complete PPE requirements.
13. Move materials into the fume hood.

**Stage 2: Procedure**

14. Measure the amount of distilled or de-ionized water to be used in creating the etchant in a graduated cylinder and pour into the

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**plastic**, labeled etchant container – This **Must have a Yellow Acid Sticker on it.**

15. Measure any other etchant constituents and add to the water in the labeled etchant container.
16. Measure the required amount of hydrofluoric acid (HF) in a **plastic** graduated cylinder and pour into the **plastic**, labeled etchant container.
17. Seal the etchant container (will be a screw lid) and place in **the Blue HF storage cabinet.**

**Stage 3: Clean-up**

18. Triple rinse all used implements and utensils with tap water, or de-ionized water from a squirt bottle (do not allow it to flow into a sink), collecting the rinse water in the labeled waste container. After triple rinsing, remove the labware and utensils from the fume hood and air dry on paper towel on a bench top.
19. Dispose of the Hazmat pads as containing trace HF even if there is no spill suspected.
20. Triple wipe all work surfaces with wet paper towel (a new towel for each wipe) and dispose of as containing trace HF if any spills occurred, or if no spills occurred dispose of as regular garbage.
21. Put cap on waste disposal container, remove it from the fume hood and place in appropriate secondary containment inside the laboratory.
22. Any solid contaminated waste (gloves, pads, paper etc.) must be placed in a labeled plastic jug with a screw type lid (NOT a bag), sealed and placed in the secondary containment tub in the laboratory, do not put them in the same container as the liquid waste.
23. **Chemical Waste or Contaminated Articles Can NOT be disposed of down the drain or in a garbage bin.**
24. Remove all labels and signs from the work area and return them to the HF usage kit.
25. The re-usable neoprene gloves can be rinsed (with the rinse water collected and disposed of as hazardous waste) if they have a minor amount of contamination, if they are majorly contaminated them should be disposed of as hazardous waste.
26. **USERS OF HF ARE RESPONSIBLE FOR THE WASTE DISPOSAL ON A MONTHLY BASIS.** Proper chemical waste disposal labels and practices must be followed at all times.
  - a. **To dispose of HF waste** the procedures are as follows:

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- i. Containers must be properly labeled, their outsides NOT contaminated and stored in the secondary waste containers.
- ii. Go to the website:  
<http://www.usask.ca/dhse/includes/HWDF.php>
- iii. Print the form and follow the instructions to fill it in properly, then fax the form to 6146.
- iv. **Note:** It is required that the waste shipment number be filled in along with the number of containers in a shipment on the ORANGE waste disposal labels.
- v. **Sample HF Entries:**

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University of Saskatchewan  
Workplace Safety & Environmental Protection  
Waste Management Facility  
FAX : 966-6146  
Disposal Questions: 966-8497  
wsep@usask.ca

Must go on labels

Changes with each shipment

**HAZARDOUS WASTE DISPOSAL FORM**

PLEASE PRINT

Date: Jan. 10, 2011  
 Department: Mechanical Engineering  
 Building & Room: Eng. OC14  
 Pick Up Location: OC14  
 (if other than above)

WASTE SHIPMENT NO: 22114  
 Number of packages in this shipment: 2  
 Contact Name: Your Name  
 Email Address: xxx123@usask.ca  
 Telephone: 8616 OR your #

Waste Description & Container Type* <small>*State type of container such as glass, metal, plastic, etc. Chemical Waste in Biohazardous Waste Bags Cannot Be Accepted.</small>	Percentage Must=100%	No. Of Containers	Total Quantity L/KG	Pkg No.
Plastic - Mixture		1	4 L	1
Hydrofluoric Acid	1			
Nitric Acid	4			
Water	95			
Plastic - Solid Waste		1	2 kg	2
Gloves, wipes, hazmat pads - trace HF				
*trace hydrofluoric acid (HF)				

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MIXTURES (more than 2 components): Print "MIXTURE" and state total quantity in container.  
 Then list all components and their concentrations by percentage to equal 100%  
 WARNING: DO NOT package incompatibles in the same container!  
 Glass bottles must be packed in sturdy containers with sufficient packing material.

**Note: No abbreviations or chemical formulas can be used on the waste disposal form, it must be the chemical's proper name.**

**Note: Other chemicals SHOULD be disposed of at the same time as the HF waste to keep waste to a minimum, if the form is not long enough simply make copies (all pages must have the same Shipment Number).**

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**PART B – USING AN ETCHANT**

**Stage 1: Setting Up**

1. Notify all persons in the area (i.e. the entire basement suite) that you will be working with HF acid.
2. Ensure that all persons in the area have read and understand the dangers of working near HF acid (they **MUST** have signed this SOP).
3. Put sign on door of 0C14 indicating that you are working with HF acid. Signs are in the HF use kit with the HF specific PPE.
4. Inspect PPE and verify all required materials are available.
5. Test eyewash station to verify its status.
6. Check emergency shower to ensure it has been inspected recently. If in doubt use a bucket to test the shower, **Do NOT use the shower without a catch bucket unless it is an emergency.**
7. Verify that Fume Hood is on and operational.
8. Label the waste disposal container.
9. Label the beakers or other containers which will sit for greater than 15 minutes with chemicals in them, masking tape labels are ok for these.
10. Review what to do in case of an accidental spill, both inside the fume hood and outside the fume hood.
11. Check the HF spill kit and confirm that the following are all present:
  - a. Safety Glasses or Goggles
  - b. Several Pairs of Neoprene or PVC gloves
  - c. 2-4 tubes of 2.5% Calcium gluconate Gel – verify expiration date
  - d. 1 litre of 1% calcium gluconate irrigation solution
  - e. 1 package of Tums/Calcium carbonate
  - f. 1 portable O<sub>2</sub> cylinder
  - g. 1 Nebulizer
  - h. 500 ml of 2.5% calcium gluconate nebulizing solution
  - i. Pocket Mask to give rescue breathing
  - j. Eye irrigator
  - k. First Aid Shears – to remove contaminated clothing
  - l. University of Saskatchewan Hydrofluoric Acid/Hydrogen Fluoride Emergency Protocol
  - m. Guidelines in case of a Hydrogen Fluoride Exposure, Comite Technique Europeen du Fluor, 2<sup>nd</sup> Edition.
12. Put on PPE. **(For work with concentrated (10% or higher) HF you MUST double glove, first disposable Nitrile then reusable**

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**Neoprene).** This includes a lab coat, apron, gloves, see the required materials list for the complete PPE requirements.

13. For solutions containing **less than 10% HF** you can double glove with two pairs of disposable Nitrile gloves, however if any contamination of the gloves occurs you **MUST** immediately remove them, re-double glove and dispose of as hazardous waste.
14. Move materials into the fume hood.

**Stage 2: Procedure**

15. Follow the Mechanical Engineering Submersion Etching Procedure MAT0031, with the following modifications:
  - a. **Do NOT** use a **glass** etching dish, use a **plastic etching dish** with either a spout or a corner for easy pouring.
  - b. Double glove at all times.
16. Seal the etchant container (will be a screw lid) and place in **the Blue HF storage cabinet.**

**Stage 3: Clean-up**

1. Triple rinse all used implements and utensils with tap water, or de-ionized water from a squirt bottle (do not allow it to flow into a sink), collecting the rinse water in the labeled waste container. After triple rinsing, remove the labware and utensils from the fume hood and air dry on paper towel on a bench top.
2. Dispose of the Hazmat pads as containing trace HF even if there is no spill suspected.
3. Triple wipe all work surfaces with wet paper towel (a new towel for each wipe) and dispose of as containing trace HF if any spills occurred, or if no spills occurred dispose of as regular garbage.
4. Put cap on waste disposal container, remove it from the fume hood and place in appropriate secondary containment inside the laboratory.
5. Any solid contaminated waste (gloves, pads, paper etc.) must be placed in a labeled plastic jug with a screw type lid (NOT a bag), sealed and placed in the secondary containment tub in the laboratory.
6. **Chemical Waste or Contaminated Articles Can NOT be disposed of down the drain or in a garbage bin.**
7. Remove all labels and signs from the work area and return them to the HF usage kit.
8. The re-usable neoprene gloves can be rinsed (with the rinse water collected and disposed of as hazardous waste) if they have a minor amount of contamination, if they are majorly contaminated them should be disposed of as hazardous waste.

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9. **USERS OF HF ARE RESPONSIBLE FOR THE WASTE DISPOSAL ON A MONTHLY BASIS.** Proper chemical waste disposal labels and practices must be followed at all times. See Part A for proper disposal details.

7. **Equipment or Materials Required**

The following Personal Protective Equipment (PPE) is required for this procedure:

- **HF COMPATIBLE SORBENT PADS (these are marked as HF Sorbent)**
- Fume Hood
- **PLASTIC** spill tray inside fume hood
- Lab Coat
- Hydrofluoric Acid (HF) approved apron or preferably coat apron (Vinyl)
- Closed Toed Shoes
- Long Pants
- Face Shield
- This SOP
- MSDS Information
- Operational Safety Shower
- Operational Eye Wash Station
- Thick Neoprene Gloves (reusable)
- Nitrile Gloves (disposable)
- HF Acid Spill and Emergency Kit, which contains:
  - Safety Glasses or Goggles
  - Several Pairs of Neoprene or PVC gloves
  - 2-4 tubes of 2.5% Calcium gluconate Gel
  - 1 litre of 1% calcium gluconate irrigation solution
  - 1 package of Tums/Calcium carbonate
  - 1 portable O<sub>2</sub> cylinder
  - 1 Nebulizer
  - 500 ml of 2.5% calcium gluconate nebulizing solution
  - Pocket Mask to give rescue breathing
  - Eye irrigator
  - First Aid Shears – to remove contaminated clothing
  - University of Saskatchewan Hydrofluoric Acid/Hydrogen Fluoride Emergency Protocol
  - Guidelines in case of a Hydrogen Fluoride Exposure, Comite Technique Europeen du Fluor, 2<sup>nd</sup> Edition.

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- **NOTE: NONE OF THE GLOVES USED IN THE LABORATORY ARE INTENDED FOR SUBMERSION USE, THEY ARE FOR SPLASH/SPILL PROTECTION ONLY.**

This procedure also requires the following:

- **PLASTIC** Liquid Waste Disposal Container with appropriate label
- Solid Waste Disposal Container with appropriate label
- **PLASTIC** bottle compatible with HF
- Soap for clean up
- Sink for clean up
- Sign for Fume hood while procedure is in progress
- Sign for Door until HF is returned to the acid storage cupboard

#### 8. **Highlights / Critical Control Points**

All workers must:

- Read and understood the Recommended Medical Treatment for HF Acid Exposure. (A copy is in the HF emergency kit and should be with this SOP).
- This procedure is not to be conducted outside of regular business hours and **MUST NOT** be conducted while working **ALONE**.
- **It is the responsibility of the Faculty Supervisors to ensure that all users of HF under their supervision/direction are competent in the use of the provided PPE and emergency response equipment (including the nebulizer and oxygen cylinder/regulator), as well as ensuring that the equipment is functional. This training will NOT be provided by the Departmental Assistant.**

#### 9. **Chemical Spill/Release and Emergency Response Procedures**

***See the University of Saskatchewan Hydrofluoric Acid/Hydrogen Fluoride Emergency Protocol for accidental exposure protocol.***

**Any Spill** involving HF must be **reported to the Departmental Assistant and your Faculty Supervisor immediately**, who will require documentation to be filled out regarding the incident.

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**Do NOT leave a chemical spill unattended without placing a sign on the door to NOT enter the room. The sign must be near the door handle and state that there is a chemical spill and do not enter.**

**Spill Response assistance is REQUIRED whenever a spill involving HF occurs outside of the fume hood:**

**Small Chemical Spills in the Fume Hood:**

Small chemical spills in the fume hood can be cleaned up by using the **HF COMPATIBLE SORBENT PADS**, thick neoprene gloves and screw lid jug. If there is any doubt regarding spill cleanup, contact WSEP Chemical Spill Team at the numbers listed below.

**Large Chemical Spills**

**DO NOT** attempt to clean up a large spill, or a spill containing highly toxic fumes that occurs outside of the fume hood. The WSEP spill team has proper breathing apparatuses to ensure their safety during spill cleanup of these types of spills.

**Any** HF containing solutions that is spilled outside the fume hood **must** be cleaned by the WSEP Chemical Spill Team. In the event of such a spill leave the immediate area immediately (with signs in place), notify anyone in the vicinity of the danger and contact the WSEP Chemical Spill Team.

**Accidental Exposure:**

**Do NOT** leave the general area until cleared to do so by the Chemical Response Team, if the immediate area is unsafe due to toxic fumes etc. leave the immediate or unsafe area (in some cases this may be the entire building) but do not leave the general area until you and your clothing are checked and released by the Chemical Response Team.

***Emergency Contact Information:***

**FIRE** Pull an alarm station AND call 9-911 (just 911 from pay phone or cell)

**CAMPUS SECURITY** 966-5555 24 hours a day

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<b>AMBULANCE</b>	9-911	(just 911 from pay phone or cell)
<b>CHEMICAL SPILLS</b>	966-8497 or 966-8493 (days)	
	966-5555	(evenings and weekends)

## 10. References

Guidelines in case of a Hydrogen Fluoride Exposure, 2<sup>nd</sup> Edition, June 2007. Comite Technique Eurpeen du Fluor.

University of Guelph, Department of Physics, Hydrofluoric Acid Use SOP.  
<http://www.physics.uoguelph.ca/~wjt/safety/SOP-HF.pdf>

Ohio State University, College of Biological Sciences Safety Page:  
Hydrofluoric Acid.  
<http://www.biosci.osu.edu/safety/SOP/SOPSHF.pdf>

University of Maryland, SOP for Use of Hydrofluoric Acid.  
<http://www.des.umd.edu/ls/sop/HydrofluoricAcid.pdf>

University of Drexel, Chemistry Department, SOP for Use of Concentrated HF.  
[http://www.materials.drexel.edu/Safety/SOP/sop\\_hydrofluoric\\_acid.pdf](http://www.materials.drexel.edu/Safety/SOP/sop_hydrofluoric_acid.pdf)

Honeywell, Recommended Medical Treatment for Hydrofluoric Acid Exposure.  
<http://membership.acs.org/F/FLUO/hfmedbook.pdf>

Guidance for Preparing Standard Operating Procedures (SOPs), United States Environmental Protection Agency (EPA), April 2007.  
<http://www.epa.gov/QUALITY/qs-docs/g6-final.pdf>

University of Saskatchewan WSEP Documents:

Chemical Safety Code (Draft):  
<http://www.usask.ca/dhse/chemicalsafety/codes.php>

Hazardous Waste Disposal:

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[http://www.usask.ca/dhse/file\\_view/download.php/Hazardous+Waste+Disposal+Manual+Aug+2007.pdf?id=3&view=1](http://www.usask.ca/dhse/file_view/download.php/Hazardous+Waste+Disposal+Manual+Aug+2007.pdf?id=3&view=1)

Laboratory Safety Manual:

[http://www.usask.ca/dhse/file\\_view/download.php/Laboratory\\_Safety\\_Manual.pdf?id=32&view=1](http://www.usask.ca/dhse/file_view/download.php/Laboratory_Safety_Manual.pdf?id=32&view=1)

Hydrofluoric Acid/Hydrogen Fluoride Emergency Protocol

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