

# Hydrofluoric Acid

## Information Sheet

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### SCOPE

This *Information Sheet* provides generic information and advice for developing and implementing *Safe Working Procedures* for staff, students, contractors and visitors working at Curtin University who are required to handle Hydrofluoric Acid (HF) or solutions containing HF.

### Introduction

HF is a liquid or gas which is the most corrosive acid known when in concentrated form. Its unique properties make it significantly more hazardous than other more commonly used acids. It has many uses including mineral digestion, surface cleaning, etching and biological staining. Small amounts of concentrated HF on the skin can be fatal, therefore laboratory personnel should not underestimate the risks associated with the acid.

### HAZARD SUMMARY

A permit is required from the [Department of Health, WA](#) for purchase and use of concentrated HF in laboratories. Areas are required to check with the Curtin [Hazardous Substances Advisor](#) to determine if the required permits are already in place prior to purchase. At a concentration of 0.1% or greater, HF is a hazardous substance under the *Occupational Health and Safety Regulations 1996*. More concentrated solutions of HF are progressively more hazardous with the most commonly available concentrations (30%-70%) being very corrosive (C+) and extremely toxic (T+).

**Dangerous goods:** HF is classified as a dangerous good under the ADG code as a DG class 8 (corrosive substance) with subsidiary risk 6.1 (toxic substance). Concentrated HF is a schedule 7 poison.

**Physical Properties:** HF is a fuming, colourless liquid at normal atmospheric pressure and less than 19°C. Above 19°C, it is hydrogen fluoride gas.

Hydrogen fluoride is industrially available as a liquid under pressure (anhydrous hydrofluoric acid) or more commonly as an aqueous solution (aqueous hydrofluoric acid) with a concentration in the range of 30-70% HF w/v.

The most common concentration for analytical grade HF is 48% HF w/v.

**Airborne (vapour) exposure limit:** TWA 3 ppm.

**Associated risk phrases:**

R26/27/28: Very toxic by inhalation, in contact with skin and if swallowed.

R35: Causes severe burns.

**Note:** Concentrated HF (70%) will fume on contact with air.

### HEALTH HAZARDS AND SYMPTOMS OF EXPOSURE

The health hazards of HF are dependent on concentration and type of exposure. Physiological damage resulting from HF exposure progresses via two pathways; a corrosive burn from the free hydrogen ions on the body surface, and a chemical burn from tissue penetration of the fluoride ions. The combination resulting in decalcification and destruction of soft tissue and bone.

<b>Skin</b>	Spillage on the skin, or splash in the eyes causes intense pain, either immediately or after some hours, resulting in a tough slow healing ulcer and progressive destruction of tissue including decalcification and necrosis of the bone. HF penetrates rapidly and deeply below fat layers binding and depleting tissue calcium. A 2% body burn from 70% HF may cause death.
<b>Eye</b>	Exposure to the eyes may result in severe pain, spasm of the eyelids, corneal damage resulting in blindness or permanent eye damage.
<b>Inhalation</b>	Mild exposure can cause coughing, choking; severe exposure may lead to breathing difficulties, muscle spasms, convulsions and death.
<b>Ingestion</b>	Mild poisoning causes nausea, vomiting, diarrhoea and abdominal pain. Severe poisoning may rapidly advance to shock, convulsions and death.
<b>Chronic</b>	Skin ulcers, bone and teeth damage and irritation of nose, throat and bronchi.

## RISK MANAGEMENT

All work with HF requires the approval of the Head of School/Division. The *Occupational Health and Safety (Hazardous Substances) Regulations 1996* require that a current Australian compliant SDS be obtained that all staff and students complete and document a full chemical risk assessment in consultation with their supervisors. Safe working procedures and emergency procedures must be developed prior to work commencing.

### Hazard Control

Control measures must be put in place to minimise exposure to HF. A thorough examination of facilities available, work flow and work processes is essential. If in doubt seek expert assistance.

### Elimination

Elimination of HF operations should be the first element of the hierarchy of controls considered.

### Substitution

In some cases substitution can be achieved using a less aggressive chemical. Great care must be taken if another fluorine containing compound is used, as HF may be generated as a by-product (e.g., bifluorides). Thoroughly review the SDS of all fluorine containing compounds prior to use. Consider purchasing HF in less concentrated form so as to avoid handling the concentrated acid.

### Engineering

Engineering controls are required to ensure that recommended exposure standards are not exceeded.

1. Ensure that the fume cupboard and ventilation systems are regularly maintained, including monitoring the pH in the scrubbing system.
2. All operations with HF must be done in an appropriate fume cupboard that contains a scrubber and wash down system. This should be used at the conclusion of processes each day.
3. Ensure that safety showers and eye wash facilities are regularly maintained.
4. Establish a designated HF work area and exclude non-essential workers from this area when HF is in use.

### Administrative

1. Do not work alone or after hours when handling HF. Have a buddy system in place. Ensure that all normal assistance services are in place (e.g. supervisor, first aiders, emergency service, and calcium gluconate near the fume cupboard).
2. Conduct and document a detailed risk assessment for the intended use of HF in the workplace.
3. Follow appropriate documented safe work procedures.
4. Train personnel in safety procedures, personal protective equipment, first aid, spills management and emergency procedures.
5. Buy and use minimum quantities of HF. The maximum size container to be purchased must not exceed 500ml to minimise decanting risks.
6. Solutions containing HF must be stored in polyethylene or Teflon containers. HF reacts with glass and, therefore, solutions containing HF are incompatible with glass storage vessels and equipment.
7. Specimen storage areas must be marked as containing HF solutions.
8. All HF solutions must be appropriately labelled with date received and then date opened.
5. Decontaminate the work area, equipment and clothing after use.
6. Provide appropriate signage indicating "HF in use".
9. Correctly labelled waste containers for the safe disposal of HF solutions are required to be provided.
7. Alert other workers in the laboratory when HF is being handled.
8. Whenever HF is being used, a second person must be in attendance and aware of the use of HF and be prepared to assist in the event of an emergency.

## Personal Protective Equipment (PPE)

Appropriate personal protective equipment must be provided and used when working with HF. PPE must be appropriately selected, individually fitted and workers trained in correct use, maintenance and disposal.

<b>Face</b>	Safety glasses in combination with a face shield.
<b>Hands</b>	Use of an outer PVC or neoprene/natural rubber blend, together with an inner nitrile surgical/examination glove, is recommended and discarded at the end of each laboratory session. Replace damaged gloves immediately. Remove gloves after task completion to avoid contamination of surfaces (e.g. before handling telephones, performing office work, leaving the laboratory, etc.).
<b>Body</b>	PVC apron complete with sleeve protection.
<b>Feet</b>	Fully enclosed leather or rubber shoes must be worn to protect the feet. No Laces.

**Note:** Contaminated PPE and clothing should be neutralised and correctly disposed of.

## Storage

The requirements for storage are outlined in AS/NZS 4452:1997, *Storage and handling of toxic substances* and the conditions of the *Poisons Permit*.

1. HF must be stored in a secure (locked), cool, dry, well ventilated area and away from sources of heat, oxidising agents, alkalis, acids, metals, silica, ceramics, organic materials, concrete and glass.
2. Store HF in original, correctly labelled container.
3. Never store in glass or metal containers as HF is highly reactive with these substances. No metal lids are to be used.
4. Containers should be stored close to ground level in a chemically resistant tray (bund). Retention measures must be in place to contain 1.5 times the volume of any HF spill.
5. Store all HF and HF waste in correctly labelled chemically compatible containers.
6. Regularly check for evidence of degradation of container and lid.
7. Regularly (e.g. annually) confirm if HF is still required and whenever possible arrange disposal. A no use period of 2 years or more is a clear trigger for disposal.

## Transport

1. Under no circumstances does Curtin authorise staff or students to transport HF between buildings or in private vehicles.
2. Where HF containers are being moved between storage rooms and laboratories within buildings, bunding is required to be used (1.5 times the total volume of the HF) so as to contain any accidental spillage.

## EMERGENCY MANAGEMENT - SPILLS

1. Due to the volatile nature of HF extreme caution should be used when dealing with spills. HF will produce highly toxic and dangerous gases on contact with ceramic surfaces, concrete and road surfaces. Do not use kitty litter or sand to contain HF spills.
2. Where there is any spill outside of a fume hood, evacuate and cordon off the area.
3. Workers must be trained in spill management.
4. A comprehensive spill kit that contains a large container of commercially produced neutralising agent such as FAST ACT should be available in the work area.

## Small amounts

1. A small spill inside a fume hood should be managed by a competent person, who is wearing suitable PPE. A suitable commercially produced neutralising agent in a shaker bottle such as FAST ACT (Mixture of titanium dioxide and magnesium dioxide), should be used directly onto the spill prior to disposal of the residue.

2.	If FAST ACT (Mixture of titanium dioxide and magnesium dioxide) is not available, neutralise the aqueous HF with a solution of calcium carbonate (20% in water) and calcium carbonate chips used in amounts sufficient to neutralise the acid in the spill area. Alternatively, slow addition of sodium bicarbonate, sodium/calcium hydroxide or sodium/calcium carbonate solid may be used to neutralise spills or unwanted HF solutions to a pH of 7.
<b>Large amounts</b>	
1.	Keep clear of liquid and visible fumes.
2.	Use your spill kit contents to contain the spill
3.	DFES to be contacted on 000 from mobiles or 0000 from landlines
4.	Alert Security on 4444
5.	Do not re-enter contaminated area until cleared by DFES to do so
<b>Waste Management</b>	
1.	For small spills management of neutralised HF liquid, place in a suitably labelled waste container for the next Chemical Waste disposal.
2.	Dispose of contaminated PPE in a labelled double bag for the next Chemical Waste disposal.
3.	For large spills, place double bagged, used spill kit contents and PPE into labelled red lidded spill bins and arrange for immediate disposal through the Chemical Waste contractor.
4.	Laboratory Manager to arrange for a specialised cleaning contractor to decontaminate the laboratory prior to recommencement of work.
<b>FIRST AID MANAGEMENT</b>	
1.	No first aid should be administered where there is the possibility of contamination of the first aid provider. Wear the appropriate PPE to reduce the risk of contamination.
2.	Any incident that involves contact with HF must be regarded as a medical emergency. Treatment for actual or suspected exposure to HF should commence immediately. Symptoms of HF exposure can be delayed. Australian Standard AS 2243 requires that calcium gluconate gel (2.5% calcium gluconate) and Caltrate tablets (500-1000mg calcium) are easily accessible and are not past their expiry date.
6.	Emergency Services to be contacted on 000 from mobiles or 0000 from landlines
7.	Alert Security on 4444
3.	Ensure that the injury party has been transported to the nearest hospital for immediate treatment.
<b>Skin Contact</b>	
Seek urgent medical attention. Prompt decontamination is essential.	
1.	Drench with water to wash off all acid.
2.	Remove all contaminated clothing including jewellery/watches/shoes. Place all contaminated clothing in a labelled plastic bag until it can be decontaminated.
3.	Wash skin; keep washing with running COLD water for 15 minutes
4.	Massage calcium gluconate gel on and around affected area every 15 minutes (wear gloves).
5.	Continue to reapply gel every 15 minutes until medical help arrives.
6.	The tube of calcium gluconate gel and SDS must accompany patient to hospital and be discarded after use.
<b>Eye Contact</b>	
Seek urgent medical attention. Consult an eye specialist.	
1.	Remove contact lenses.
2.	Hold eye open and flood eye with gently running water for at least 15 minutes, ensuring that the flow of water does not contaminate the unaffected eye.
3.	Continue flushing with water or isotonic saline during transport.
4.	Sterile 1% calcium gluconate solution may be used in eyes under medical supervision.
<b>Ingestion</b>	
Seek urgent medical attention.	
1.	Never induce vomiting. Vomited material should be regarded as contaminated.
2.	If conscious rinse mouth out with water.

3. If conscious and able to drink give small amounts of milk, water or calcium containing antacid.
<b>Inhalation</b>
Seek urgent medical attention.
1. Rescuers should wear respiratory apparatus if available.
2. Remove affected person to fresh air.
3. Oxygen can be administered by a trained person.
4. Seek urgent medical assistance.
5. Medical attention must be sought even if there are no symptoms.
<b>POWER FAILURE OR FUME HOOD FAILURE</b>
In the event that there is a malfunction of the fume cupboard it is vitally important to make the workplace safe. Do not enter an area where HF operations are taking place if there has been a power failure or fume cupboard alarms are operating.
1. Cease all HF operations, decanting etc
2. Switch off electrical devices.
3. Lower the fume cupboard sash.
4. Exit the laboratory.
5. Evacuate the immediate area.
6. Dial 4444.
7. Report the fault to management.
8. If an evacuation is called whilst using HF, pull down the sash down on the fume cupboard, switch off all electrical devices and proceed with the evacuation.
<b>HF INFORMATION PACK</b>
As part of safe working procedures it is highly advisable to have an <i>HF Information Pack</i> available for emergency personnel and medical practitioners. It is recommended that the information pack contains:
<ul style="list-style-type: none"> <li>• A copy of the <i>Risk Assessment</i>;</li> <li>• A copy of the <i>SDS</i>; and</li> <li>• A copy of "<a href="#">Hydrogen Fluoride</a>" guide produced by Safe Work Australia.</li> </ul>
<b>HF CHECKLIST</b>
Below is a checklist to be used prior to starting work with HF.
<input type="checkbox"/> Risk assessment and Operational Procedures completed for the use of HF. <input type="checkbox"/> Emergency Procedures reviewed. <input type="checkbox"/> Fume cupboard contains a scrubber unit and has been designated for use with HF (label affixed indicates this) <input type="checkbox"/> Fume Cupboard for HF work is in full working order. Check: <ul style="list-style-type: none"> <li><input type="checkbox"/> Power</li> <li><input type="checkbox"/> Extraction</li> <li><input type="checkbox"/> Sash operability</li> <li><input type="checkbox"/> Passed annual maintenance and last inspection and testing</li> </ul> <input type="checkbox"/> Emergency shower and eye wash are immediately accessible and in full working order. <input type="checkbox"/> Clear entry signage highlighting the use of HF in the laboratory with a list of emergency contacts. <input type="checkbox"/> Spill Kit is available. <input type="checkbox"/> Calcium gluconate gel is available and in close proximity to the designated fume cupboard. <input type="checkbox"/> The HF container is sound and the pouring mechanism is suitable for use. <input type="checkbox"/> Full PPE is available for both the operator and "buddy". <input type="checkbox"/> All personnel trained in the use of PPE. <input type="checkbox"/> The HF information pack is complete and available in case of an incident.
<b>References</b>
<p>[1] <i>Occupational Health and Safety Regulations, 1996</i></p> <p>[2] <i>AS/NZS 4452:1997, Storage and Handling of Toxic Substances</i></p> <p>[3] <i>AS/NZS 2243: 2004 Safety in Laboratories</i></p> <p>[4] "<a href="#">Hydrogen Fluoride</a>" guide produced by Safe Work Australia</p>