

STANDARD OPERATING PROCEDURE - SOP

TITLE:	GOOD PRACTICES AND SAFETY IN THE USE OF HYDROFLUORIC ACID (HF) IN THE LABORATORY
CODE/VERSION:	001
DATE OF APPROVAL	02/SEP/2025

1.0 OBJECTIVE

This document aims to establish guidelines for good practices and safety in the handling of Hydrofluoric Acid (HF) in the laboratory environment.

2.0 DEFINITIONS

HF is formed by the dissolution of hydrogen fluoride gas in water. It is a colorless, non-flammable liquid with a pungent odor. Despite being classified as a weak acid in terms of dissociation, HF is extremely dangerous due to its ability to penetrate biological tissues, causing tissue destruction and systemic compromise. HF reacts rapidly with calcium and magnesium in the body, potentially leading to hypocalcemia, cardiac arrhythmias, and death.

At LEGAL, HF is used for the preparation of quartz and feldspar concentrates used in luminescence dating. HF is used to remove superficial layers of quartz or feldspar grains (sand fraction) affected by alpha radiation. In the case of quartz concentrate preparation, HF also helps to remove feldspar grains remaining from mineral separation through decantation in heavy liquid (lithium metatungstate).

3.0 RISKS AND PREVENTION

3.1 Associated Hazards and Risks

HF is classified as highly toxic (fatal by inhalation, ingestion, and dermal contact) and corrosive (causing severe skin burns and eye injuries). Symptoms of exposure may be immediate at high concentrations or delayed at lower concentrations (up to 24 hours). This delay may create a false sense of safety and delay proper medical care.

Inhalation exposures may cause pulmonary edema, chemical bronchitis, and death. Dermal contact can cause deep burns, necrosis, and systemic intoxication, while eye

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contact may result in blindness. It is emphasized that good practice precautions are essential since even small amounts of HF can be fatal.

3.2 Preventive Measures and Training

Only personnel trained in this SOP and who have achieved a score of at least 7.0 in the evaluation are authorized to handle HF within LEGAL. Knowledge of first aid and emergency procedures is essential, in addition to familiarity with the location of first aid kits and HF-specific spill kits.

3.3 Personal and Collective Protective Equipment

Due to the high toxicity of HF, its handling requires strict protection control. For this, personal and collective protective equipment are essential. They are:

Personal Protective Equipment (PPE):

- Lab coat (cotton, fully closed) and impermeable apron (PVC or neoprene);
- Double nitrile gloves extending to the forearm;
- Safety goggles;
- Respiratory protection with filter (with or without shield);
- Long pants and closed-toe shoes at all times.

Collective Protective Equipment (CPE):

- Fume hood (with exhaust on during all manipulations);
- Emergency eye wash and shower;
- First aid kit with 2.5% calcium gluconate gel;
- HF-specific spill kit (calcium-based neutralizers).

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4.0 STORAGE AND DISPOSAL

4.1 Safe Handling and Storage

HF must always be handled inside properly functioning fume hoods, and the use of plastic trays for containing possible spills is recommended. Transport must be carried out in a hermetically sealed secondary container. Storage of HF in compatible plastic containers (PE, PTFE, and PP) is mandatory, and storage in glass, ceramic, or metal containers is strictly prohibited, as HF reacts aggressively with these materials. It must be emphasized that HF bottles stored in the laboratory must be kept in a ventilated area, properly labeled with hazard signage, and must never be stored near strong bases, solvents, or other incompatible substances.

4.2 Waste Management

HF waste must be neutralized with calcium carbonate. Disposal of HF in sinks or sewage systems is **prohibited**. Neutralized waste must be stored in labeled plastic containers and sent to the Chemical Waste Management System of the Institute of Geosciences at USP (IGc). Empty HF bottles must also be stored in an appropriate location for proper later disposal.

5.0 PROCEDURES IN CASE OF ACCIDENTS

In any suspected exposure to HF, medical care must be sought immediately. It should be emphasized that the first responder must protect themselves with PVC gloves to provide first aid to the victim and accompany them to the hospital along with the recommendations of the “*Administrative Norms Related to Activities with Hydrofluoric Acid*” issued in Ordinance No. 13 – D Log of the Brazilian Army, which address the “*Instruction Guide for First Aid with Hydrofluoric Acid*” (Annex A) and “*Medical Treatment*” (Annex B). Both annexes of the Brazilian Army Guide are printed and posted at the entrance of the LEGAL sample preparation room (“dark room”).

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The main recommendations described in Annex A of the Instruction Guide for First Aid with Hydrofluoric Acid are:

- *After inhalation:*

Exposure to fresh air. Consult a physician. Keep the respiratory tract clear. In case of respiratory arrest: immediately perform cardiopulmonary resuscitation; provide oxygen if available. Do not perform mouth-to-mouth resuscitation.

- *After skin contact:*

Immediately remove contaminated clothing. Rinse with copious amounts of water for at least 10 minutes. Apply 2.5% calcium gluconate gel and massage into the skin for a few minutes; meanwhile, rinse again with water and reapply fresh gel. Continue gel therapy for another 15 minutes. If sodium gluconate is not available, apply several compresses completely soaked with 20% calcium gluconate solution or magnesium hydroxide (milk of magnesia, Maalox, or similar). Medical attention is absolutely required!

- *After eye contact:*

Rinse thoroughly with plenty of water, keeping eyes open and protecting the unaffected eye (for at least 10 minutes). Apply calcium gluconate solution. Seek medical advice immediately!

- *After ingestion:*

Give plenty of water to drink. Warning: Do not induce vomiting!!! Risk of gastric perforation!

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5.1 Procedures in case of Spillage:

In case of small spills (<20 mL) of HF on the bench or floor, containment must be carried out using the spill kit containing calcium carbonate to neutralize the reagent chemical. Water, detergent, or other inappropriate chemicals must never be used, as such compounds do not properly neutralize fluoride and may generate toxic vapors.

In case of large spills, the first recommendation is evacuation of the area, alerting the safety team and firefighters.

6.0 REFERENCES

BRASIL. Exército. Departamento Logístico. Portaria nº 13 - D Log, de 19 de julho de 2006. Aprova as Normas Administrativas Relativas às Atividades com Ácido Fluorídrico – NARAAF. Diário Oficial [da] República Federativa do Brasil, Brasília, DF, jul. 2006.

CORNELL UNIVERSITY. Hydrofluoric acid safety guideline. Ithaca, NY: Cornell University, [s.d.]. Disponível em: <https://ehs.cornell.edu/research-safety/chemical-safety/laboratory-safety-manual/chapter-8-chemical-hazards/89-0> Acesso em: 26 ago. 2025.

HARVARD UNIVERSITY. Lab safety guideline: hydrofluoric acid. Cambridge, MA: Harvard University, 2019. Disponível em: <https://www.ehs.harvard.edu>. Acesso em: 26 ago. 2025.

PROLINK QUÍMICA. Ficha de informação de segurança de produto químico – Ácido Fluorídrico 70%. [S.l.]: Prolink Química, 2024. Disponível em: https://prolinkquimica.com.br/upload/2024/05/fq_014_07-acido-fluoridrico-70.pdf. Acesso em: 25 ago. 2025.

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WISCONSIN–MADISON UNIVERSITY. Environmental Health & Safety. Safe handling of hydrogen fluoride and hydrofluoric acid. Madison, WI: UW–Madison, 2020.

Disponível em: <https://ehs.wisc.edu/wp-content/uploads/sites/1408/2020/08/SafeHandlingOfHydrogenFluorideAndHydrofluoricAcid.pdf>. Acesso em: 25 ago. 2025.