



STANDARD OPERATING PROCEDURE

ACID HANDLING

College/Dept: Mines and Earth Science	Building/Room: FASB 468, 472, 476, 479, 482
Laboratory Name: EARTH Core ICP-MS Facility	Revision: 2 – April 11, 2019
Principal Investigator: Diego P. Fernandez	Author: v0.1 Billy Nguyen v1.0 Diego Fernandez v1.1 Michael Simpson v2.0 Christopher Anderson

Before the worked detailed in this procedure may begin, the intended user must read, understand and sign this document. This document must be approved by the PI and a member of the college safety committee. Any changes to this document, however minor, must be submitted for approval by the PI, a member of the college's safety committee. The "buddy system" will be in place whenever any work is conducted.

Approval

Reviewed and Approved by: _____	_____	_____
Name, Title	Signature	Date
_____	_____	_____
Name, Title	Signature	Date

Overview

Acids are a very common type of chemical found in science and engineering labs that can be harmful for operators through inhalation or skin contact. Some acids are also strong oxidizers and can cause fires or explosions when mixed with other compounds. Acids can be solids, liquids or gases. Some acids can also be unstable or highly hygroscopic. Read Safety Data Sheets (SDS) for all chemicals used for a complete list of hazards and incompatibilities.

This standard operating procedure (SOP) provides guidelines for storage, usage and disposal for small amounts of the most common acids in order to prevent injuries and/or minimize damage when an accident occurs. This SOP does not cover hydrofluoric acid, gases and other corrosive chemicals; which require additional precautions beyond the general handling procedures outlined here. Chemical compatibility between acids, labware, and protective materials is minimally covered; and research must be done before implementing new protocols for substances or materials not mentioned here.

Roles and Responsibilities

PI & Supervisory Staff:

1. Purchase and catalog chemicals used in facility
2. Scheduling waste management and pickups

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3. Training use and best practices to technical staff and students

Staff & Students:

1. Monitor condition of workplaces and keep them clean and free of clutter to minimize accidents
2. Monitor condition of containers and lab equipment used with acids to confirm they are in working order
3. Disposing of used chemicals in proper containers
4. Notifying PI/supervisors of any issues or emergencies that may arise due to handling of acids

PI: Diego Fernandez

Manager: Christopher Anderson

Trainers: Stephanie Aswad, Bradley Munk, Eric Merchel, Casey Wood

Scope

This procedure gives general instructions and precautions to safely store, dispose, open containers of, transfer, pipette, dilute and evaporate acidic chemicals without harm to self or equipment.

This document is intended to supplement, but not replace, training from an experienced user.

The chemicals in which this document specifically covers are hydrochloric acid (HCl); nitric acid (HNO₃); phosphoric acid (H₃PO₄); sulfuric acid (H₂SO₄); hydrobromic acid (HBr); acetic acid (CH₃COOH)

Prerequisites

Each new user must review this SOP and be trained by an authorized user.

Potential Hazards

Contact: Acids are corrosive and can destroy living tissue including skin, eyes, mucous membranes and respiratory tract at point of contact

Inhalation: Vapor from acidic solutions and dust from acidic solids can react with the water on skin, mucous membranes and respiratory tract to cause injury to tissues

Ingestion: Concentrated acids used in this facility may be fatal if swallowed

Hazard Specifics: Chemical burns, poison

Comments:

Engineering Controls (EC)

Fume hood Biosafety Cabinet Other Local Exhaust Shielding Other

EC Specifics: Chemical bench station, re-filling station, laminar flow bench

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Training Requirements – except for classroom lab safety, must be completed prior to performing the procedure

- | | |
|--|---|
| <input checked="" type="checkbox"/> Chemical Hygiene Training | <input type="checkbox"/> Fire Extinguisher Training |
| <input type="checkbox"/> Radioactive Materials | <input type="checkbox"/> Hazard Communication Awareness |
| <input type="checkbox"/> Analytical X-ray | <input type="checkbox"/> Biosafety Level 2 |
| <input type="checkbox"/> AED Plus | |
| <input type="checkbox"/> AED/CPR | |
| <input checked="" type="checkbox"/> Other (specify): ICP-MS Clean Labs SOP; Milli-Q SOP, Pipettor SOP, Plastic Acid Leaching SOP | |

Personal Protective Equipment (PPE)

- | | | | |
|--|---|---|---|
| <input checked="" type="checkbox"/> Safety glasses | <input type="checkbox"/> Safety goggles | <input type="checkbox"/> Face shield & safety glasses | <input type="checkbox"/> Face shield & safety goggles |
| <input checked="" type="checkbox"/> Lab coat | <input type="checkbox"/> Apron | <input type="checkbox"/> Tyvek suit | <input checked="" type="checkbox"/> Tyvek sleeves |
| <input checked="" type="checkbox"/> Nitrile gloves | <input checked="" type="checkbox"/> Leg coverings | <input type="checkbox"/> Hard hat | <input type="checkbox"/> Hearing protection |
| <input type="checkbox"/> Respirator | <input checked="" type="checkbox"/> Shoes | <input type="checkbox"/> Fall protection | <input checked="" type="checkbox"/> Other |

Other: polyester liners for gloves; vinyl gloves for mineral acids.

These are the minimum requirements for handling acids. Additional PPE such as safety goggles and face shields may also be used but are not required. Other common glove materials are compatible in most cases as well.

Equipment, Materials, Supplies, & Facility Requirements

Plastic boxes for secondary containment, pipettors, pipette tips, acid-leached plastic containers, wipes, tip disposal box, acid waste container, spill kit, parafilm, scissors, zip-lock bags

Handling, Work Area & Storage Requirements

Handling: Acids for chemical labs are usually purchased in containers not larger than 2 L. Always handle these larger bottles in fume hood (FH1 or FH4) or exhausted chemical bench under laminar flow (DS1 and DS2). Only handle the smallest possible amounts in work areas. Always use secondary containment for open stock bottles in work areas.

Work Area: chemical bench under laminar flow (LF1, LF2, LF3 and LF5)

Storage: For containers with volume larger than 1 L store in exhausted chemical cabinet or exhausted fume-hood under cabinet (FH1, FH2, FH3, FH4). For plastic bottles with volumes smaller than 1 L containing stock acids in chemical work areas. Never store acids with organic materials.

Emergency Response Equipment & Supplies

- | | | | |
|---|--|---|---|
| <input checked="" type="checkbox"/> Eyewash | <input type="checkbox"/> Fire extinguisher | <input checked="" type="checkbox"/> First aid kit | <input type="checkbox"/> Calcium gluconate gel (HF use) |
| <input checked="" type="checkbox"/> Safety shower | <input type="checkbox"/> Fire blanket | <input checked="" type="checkbox"/> Spill kit | <input type="checkbox"/> Emergency gas shutoffs |
| <input type="checkbox"/> Drench hose | <input type="checkbox"/> Other: | | |

Description: Eyewash and shower are located in hallway between 476 and 472. Spill kits and first aid kits are located in each lab.

Decontamination & Waste Disposal

1) Decontamination:

For spills within secondary containment box follow "2) Waste Disposal."

For spills or splashes on chemical bench station, gloves, sleeves or other PPE: use clean room polyester wipes. Put wet wipes in plastic box and leave the box open in fume hood.

Never attempt to neutralize acid spills with bases.

2) Waste Disposal:

Dispose acids in 2.5 Gal "Acid Waste" disposal container supplied by OEHS.

Never dispose organic liquids, bases or corrosives other than acids in "Acid Waste" container.

Never dispose hot acids in "Acid Waste" container.

Always dilute concentrated acid volumes larger than 20mL by pouring into a container with at least twice as much water before disposing in waste container.

When disposing the content of many small containers (tubes, vials, small bottles) use a 250mL plastic container to consolidate before disposing in "Acid Waste" container

Acid wet empty containers must be dried in fume hood before disposing in plastic recycling containers.

Spill Response

For large volumes (>1 L) warn others, exit the lab and call your supervisor. Never attempt to use a respirator if you have not been trained. Fill an Incident/Near Miss report (<https://oehs.utah.edu/topics/incidentnear-miss-report>).

For moderate volumes use spill kit only when fumes level is low and only for a short amount of time (< 5 min). Fill an Incident/Near Miss report (<https://oehs.utah.edu/topics/incidentnear-miss-report>).

For volumes no larger than 20mL use wipes. Put wet wipes in plastic box, and the box open in fume hood until dry.

Additional Safety Information

If an acid is swallowed look for help and call Utah Poison Control at +1 (800) 222-1222

For spills or splashes on exposed skin: rinse with cold water for at least 15 minutes, get help and go to RedMed in the Union building for a medical assessment.

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For spills or splashes on exposed clothes: remove contaminated clothing article, rinse skin with cold water for at least 15 minutes, get help and go to RedMed in the Union building for a medical assessment.

For small spills or splashes on PPE wipe with paper towel and rinse with wipe and Milli-Q water.

Be very careful when taking PPE off, do not touch outside surface of gloves with skin. Always assume small drops of the chemical may be on them.

References

Glove compatibility guides:

https://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf

<https://www.allsafetyproducts.com/sitemap.php>

<http://www.showabestglove.com/site/default.aspx>

Procedure

0. Opening containers with corrosive liquids.
 - ! **Always be extremely careful when opening bottles, tubes or vials containing corrosive liquids. Threads of screw caps may be contaminated. Snap caps are especially dangerous because they can project drops. Open gently and use a wipe, parafilm or zip-lock bag for protection. When caps of centrifuge tubes are visibly contaminated, they can be centrifugated to collect liquid in bottom. Never leave open containers with corrosives untended.**
1. Re-filling PTFE stock containers (50-1000 mL) with concentrated acid.
 - 1.1 Take acid container (no larger than to 2 L) from storage and place in fume hood (AR grade acids) or exhausted chemical bench under laminar flow (Trace Metal Grade or SeaStar grade acids). Place PTFE stock container in clean secondary containment plastic box near acid container. Open both containers and place lids inside a zip-lock bag. Fill PTFE stock container by pouring, close both containers and return to storage areas.
2. Diluting or transferring acids in chemical area in laminar flow bench
 - 2.0 Always have a written plan or recipe indicating the solutions and volumes to mix or transfer.
 - 2.1 Label all containers with names of unknowns, acid species and concentration
 - 2.2 Use a smaller PTFE vial (7, 15, 22 or 35 mL) filled with the acid to pipette from. In order to re-fill this vial, pour from stock acid bottle with both bottle and vial inside a clean plastic secondary containment box.
 - 2.3 Always acid leach pipette tip before pipetting trace metal grade acids from PTFE vial
 - 2.4 Use pipettors for 0.002 – 25 mL. Use polystyrene (PS) autosampler tubes to measure volumes 25-100 mL
 - 2.5 Always add the acid in small amounts to cold water for dilution
 - 2.6 For dilute acids use squeeze bottle to fill tubes to the desired volume. Always keep squeeze bottle with beak pointing away from you
 - 2.7 Use parafilm to close non-capped tubes containing acids for temporary storage or mixing
 - 2.8 Be sure to log any deviations or mistakes in digital recipe or on the corresponding sample in the lab management database
3. Evaporating acids in PTFE vials (only for volatile acids HCl, HNO₃, CH₃COOH)
 - 3.1 Inspect drying station selected (DS1 or DS2); check for integrity of PTFE film on hot plate and clean wipe surfaces as needed using Milli-Q water
 - 3.2 Select PTFE vials with a volume at least twice the amount of acid to be evaporated. Label vials using PTFE compatible marker (can be distinguished by gold "special" label)
 - 3.3 Pipette acid into the corresponding vials and log volumes that were transferred into lab notebook
 - 3.4 Place PTFE vials in corresponding green rack, and the rack with vials inside a clean transport plastic box. Close the box
 - 3.5 Transport the box into drying station (DS1 or DS2)
 - 3.6 Select heating block for the PTFE vials and put block on hot plate.
 - 3.7 Open PTFE vials one by one, place lid inside transport box upside down and place vial in heating block well. Close transport box with lids after all vials are opened
 - 3.8 Set hot plate temperature (maximum 240°C)
 - 3.9 Put on polyester liners under gloves
 - 3.10 Rotate and tap vials in order knock down condensation on walls
 - 3.11 Remove vial from hot block once a small drop (50-100 µL) is left and put on green rack. Let it cool down and check complete evaporation (if needed) after a few minutes
 - 3.12 Close vials and transport box to chemical working area

APPENDIX:

