



Corrosives- Strong Acids

H290 H314 H315 H316 H318 H319 H320



Areas with blue text indicate that information must be provided or modified by researcher prior to the SOP approval.

This SOP is not a substitute for hands-on training.

Print a copy and insert into your laboratory SOP binder.

Department:	Chemistry
Date SOP was written:	Monday, October 24, 2016
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	Name: R. Sarpong Signature: _____
Internal Lab Safety Coordinator or Lab Manager:	Name: Melissa Hardy/Justin Jurczyk Lab Phone: 406-696-1225/412-728-1952 Office Phone: 510-642-6312
Emergency Contact:	Name: Melissa Hardy/Justin Jurczyk Lab Phone: 406-696-1225/412-728-1952
Location(s) covered by this SOP:	Latimer Hall 831,832,834,836,837,838,839,842,844,847,849

1. Purpose

This SOP covers the precautions and safe handling procedures for the use of Corrosives - Strong Acids. For a list of Corrosives - Strong Acids covered by this SOP and their use(s), see the "List of Chemicals". Procedures described in Section 12 apply to all materials covered in this SOP.

If you have questions concerning the applicability of any recommendation or requirement listed in this procedure, contact the Principal Investigator/Laboratory Supervisor or the campus Chemical Hygiene Officer at ucbcho@berkeley.edu.

2. Physical & Chemical Properties/Definition of Chemical Group

A strong acid is one that completely ionizes (dissociates) in a solution. (See Appendix for a complete list of Strong Acids.)



3. Potential Hazards/Toxicity

All acids in this class are highly corrosive chemicals. Inhalation may cause irritation to the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath, and pulmonary edema. Contact with skin causes burns and irritation. Eye contact causes burns, irritation, and may cause blindness. Ingestion may cause permanent damage to the digestive tract.

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) designates corrosives by one or more of the following H codes:

- H290** May be corrosive to metals
- H314** Causes severe skin burns and eye damage
- H315** Causes skin irritation
- H316** Causes mild skin irritation
- H318** Causes serious eye damage
- H319** Causes serious eye irritation
- H320** Causes eye irritation

Strong Acids may also have other hazardous properties in addition to corrosivity. Safe use requires assessing all potential hazards.

It is the Principal Investigator’s responsibility to ensure activity-specific laboratory procedures and/or processes are taken into account when using this Chemical Class SOP.

Please, review the SDS of any chemical before use (see Section 11 – SDS Location)

Additional notes on chemical-specific hazards:

- Hydrofluoric acid: Causes severe burns that may not be immediately painful or visible. Symptoms of skin exposure may be delayed 8 hours or longer. Requires treatment with calcium gluconate – **Chemical-specific SOP required.**
- Nitric acid – Strong oxidizer; may ignite or explode on contact with organic compounds.
- Perchloric acid – Strong oxidizer; may form explosive compounds – **Chemical-specific SOP required.**
- Sulfuric acid can act as an oxidizer resulting in charring and decomposition of organic materials; it may act as a chemical de-hydrating agent, abstracting the elements of water from a molecule, sometimes forming flammable gases; sulfuric acid has a high heat of dilution.

4. Engineering Controls

Use the engineering controls listed below unless other lab-specific information is included in the Protocol/Procedure section.

- Work with Corrosives – Strong Acids must be conducted in a fume hood unless other controls are designated in the lab-specific Protocol/Procedure section. Sash height must be kept as low as possible to avoid escaping fumes and provide a physical barrier.



- Laboratories and rooms where strong acids are used must have general room ventilation that is negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.

5 - Personal Protective Equipment

At a minimum, the following PPE must be worn at all times.

Eye and Face Protection

- A. ANSI Z87.1-compliant safety glasses with side shields, or chemical splash goggles.
 - Ordinary prescription glasses will NOT provide adequate protection unless they also meet ANSI standard and have compliant side shields.
- B. If the potential for explosion/splashing exists, and adequate coverage is not provided by the hood sash, a face shield must be worn.

Skin and Body Protection

- A. Gloves are required when handling hazardous chemicals.
 1. Refer to specific chemical SDS for information on glove selection.
 2. For additional information on glove selection, go to:
<http://ehs.berkeley.edu/hs/63-laboratory-safety/94-glove-selection-and-usage.html>
- B. Lab coats are required when handling hazardous chemicals in the lab. Select the type of lab coat according to the substances at the specific workplace.
- C. Long pants, closed-toe/closed-heel shoes, covered legs, and ankles.

Respiratory Protection

Respiratory protection is normally not required for UC Berkeley laboratory activities. Any lab personnel considering the use of a respirator (e.g. N-95 respirator, dust mask) must contact EH&S for a workplace assessment.

6. First Aid Procedures and Medical Emergencies

In the event of an injury, notify your supervisor immediately and EH&S within 8 hours.



Go to the Occupational Health Facility (Tang Health Center, on campus); if after hours, go to the nearest emergency room (Alta Bates, 2450 Ashby Ave in Berkeley); or



Call 911 (from a cell phone: 510-642-3333) if:

- *it is a life threatening emergency; or*
- *you are not confident in your ability to fully assess the conditions of the environment and/or the condition of the contaminated/injured person, or you cannot be assured of your own safety; or*
- *the contaminated/injured person is not breathing or is unconscious.*

Please remember to provide a copy of the appropriate manufacturer SDS (if available) to the emergency responders or physician. At a minimum, be ready to provide the identity/name of any hazardous materials involved.

Note: Hydrofluoric Acid (HF) burns require immediate and specialized first aid and medical treatment. Symptoms may be delayed up to 24 hours depending on the concentration of HF. First aid requires treatment with calcium gluconate. See Chemical Specific HF SOP for more details.



In case of skin contact

Immediately drench in the safety shower with copious amounts of water for no less than 15 minutes to remove any remaining contaminants; remove any jewelry or clothing as necessary to facilitate clearing of any residual materials. Wash off with soap and plenty of water for 15 minutes.

In case of eye contact

Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible.

If swallowed

Do NOT induce vomiting unless directed otherwise by the SDS. Never give anything by mouth to an unconscious person. Rinse mouth with water.

Needle stick/puncture exposure

Wash the affected area with antiseptic soap and warm water for 15 minutes.

If inhaled

Move into fresh air.

7. Special Handling, Storage, and Disposal Requirements

Lab-specific information on handling and storage may be included in the Protocol/Procedure section.

Precautions for Safe Handling

- Do not allow water to get into the containers because of potentially violent reactions. Do not get in eyes, on skin, or on clothing.
- When mixing with water, always add acids slowly to the water and stir continuously. Never add water to acid.
- Strong acids that are also oxidizers may react violently with organic compounds.
- Eliminate or substitute for a less hazardous material when possible.
- Design your experiment to use the least amount of material possible to achieve the desired result.
- Do not exceed the scale of procedures specified in Protocol/Procedure section without approval of the PI.
- Verify your experimental set-up and procedure prior to use.
- Know the location of the nearest eyewash, safety shower and fire extinguisher before beginning work.
- Upon leaving the work area, remove any personal protective equipment worn and wash hands.
- At the end of each project, thoroughly decontaminate the work area according to the material being handled.

Conditions for Safe Storage

- Store in a cool, dry, well-ventilated area away from incompatible substances.
- Strong acids must be stored in isolation from all other chemicals in an approved acid or corrosives safety cabinet. If no corrosive cabinet available, use secondary container to store acids.

Disposal

- Waste materials generated must be treated as a hazardous waste.



- The empty container must be rinsed three times with a COMPATIBLE solvent; leave it open in the back of the hood overnight. Solvent rinses and water rinse must be disposed of as hazardous waste.
- As an alternative, unrinsed empty containers can be disposed of through EH&S as hazardous waste. The unrinsed empty containers must be capped.
- Do not mix with incompatible waste streams.
- Decontamination of the empty container in order to use it for other purposes is not permitted.

8. Chemical Spill

Spill – Assess the extent of danger; if necessary request help by calling **911** (from a cell phone: **510-642-3333**) for emergency assistance or 510-642-3073 for non-life threatening situations. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors from spill. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- **Minor Spill** – In the event of a minor spill, if there is no potential for hazardous chemical exposure, report the spill to 510-642-3073 and if you are trained, proceed to clean it. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and request pick-up.
- **Major Spill** – Any hazardous chemical spill that involves chemical exposure, any chemical spill that due to size and/or hazard requires capabilities beyond your training, or any chemical spill that gives the perception (because of odor, for example) that there has been a hazardous release. Call **911** or 510-642-3073 for assistance.

9. Cleaning and Decontamination

Lab-specific information on decontamination may be included in Section 12 - Protocol/Procedure.

- Wearing proper PPE, laboratory work surfaces must be cleaned at the conclusion of each procedure and at the end of each work day.
- Decontaminate all equipment before removing from a designated area.

10. Hazardous Waste Disposal

Label Waste

- Label all waste containers. See the EH&S Fact Sheet, “Hazardous Waste Management” for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

- Dispose of regularly generated chemical waste within 6 months.
- Contact EH&S at 642-3073 if you need assistance.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at <http://ucsd.edu>



-Take Ownership of Your Safety-



Before starting any work, ask yourself:

- 1- **What will I be doing?**
- 2- **Do I know what the hazards are?**
- 3- **Do I have everything I need to do the job safely?**
- 4- **Am I doing the job safely?**
- 5- **What can we do better?**



12. Protocol/Procedure – Corrosives – Strong Acids

Section 12 must be customized to your specific needs. Delete any procedure that does not apply to your laboratory.

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
1. Preparation of dilute solutions of acid (typically 0.1-6 M).	<p>Up to 2 L as supplied in the reagent bottle.</p> <p>Total volume to be handled at any given time: Up to 2 L of dilute solution.</p> <p style="color: red;">Remember to obtain PI approval if higher scale is necessary.</p>	<p>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.</p>	<p>Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.</p> <p>Face Protection: Face shields are to be used when there is no protection from the hood sash.</p> <p>Hand protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Inspect gloves prior to use. For dilute solutions (less than 3M) use standard nitrile; up to 6M acid use Viton or thicker nitrile or double glove; for more concentrated solutions to concentrated commercial grade use laminate film material, neoprene, or polyvinyl chloride gloves. If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear an acid resistant apron when handling the chemical as supplied in the reagent bottle or when there is the potential for splashing.</p>	<p>Always add acid to water to avoid spattering. Do not add water to acid.</p> <p>Ensure that all glassware is clean and dry before beginning procedure.</p> <p>Determine the amounts of acid and water required for the dilution.</p> <p>Transfer the concentrated acid to a beaker for easier handling.</p> <p>Measure the concentrated acid, and slowly add it to the bulk water component. A pipettor, or other means can be used to control the flow of acid, to slowly add the acid into a container of water until the acid has been diluted.</p> <p>Note: if temperature becomes too warm, stop addition immediately. Wait for the solution to cool down before proceeding with addition.</p> <p>Dilute the resulting, cooled solution to the final volume.</p> <p>Place a stopper or lid securely on the flask and invert several times to thoroughly mix.</p>
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
2. Use of dilute acid solutions in a reaction, or reaction work up.	Up to 2 L of dilute acid solution. Remember to obtain PI approval if higher scale is necessary.	All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.	Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. Face Protection: Face shields are to be used when there is no protection from the hood sash. Hand protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Inspect gloves prior to use. For dilute solutions (less than 3M) use standard nitrile; up to 6M acid use Viton or thicker nitrile or double glove; for more concentrated solutions to concentrated commercial grade use laminate film material, neoprene, or polyvinyl chloride gloves. If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use. Clothing: Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear an acid resistant apron when there is the potential for splashing.	Hydrochloric acid is corrosive and hazardous by inhalation. Wear gloves and use in a well ventilated hood. Eliminate incompatible materials from the potential spill area. NOTE: Make sure that solvent and all components are compatible with the acid. Transfer desired quantity of diluted acid to a flask containing desired amount of water or solvent using a glass pipette. Proceed with reaction. After the reaction, dilute with water, quench with mild base. Check pH of solution before disposing as aqueous chemical waste. Dispose of all contaminated material according to the strong acid disposal protocol.
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
3. Quenching reactions or washing organic solutions with diluted acid.	Up to 500 mL of dilute acid solution per quench or wash. Remember to obtain PI approval if higher scale is necessary.	All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.	Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. Face Protection: Face shields are to be used when there is no protection from the hood sash. Hand protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Inspect gloves prior to use. For dilute solutions (less than 3M) use standard nitrile; up to 6M acid use Viton or thicker nitrile or double glove; for more concentrated solutions to concentrated commercial grade use laminate film material, neoprene, or polyvinyl chloride gloves. If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use. Clothing: Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear an acid resistant apron when there is the potential for splashing.	The use of dilute acid solutions to quench or wash organic solutions is typically performed using a separatory funnel. Use caution and vent pressure build up in the separatory funnel often. Aim funnel spout toward back of hood when venting.
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
4. Use of strong acid in a reaction.	Up to 100 mL of strong acid as supplied in the reagent bottle. Remember to obtain PI approval if higher scale is necessary.	All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.	Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. Face Protection: Face shields are to be used when there is no protection from the hood sash. Hand protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Inspect gloves prior to use. For dilute solutions (less than 3M) use standard nitrile; up to 6M acid use Viton or thicker nitrile or double glove; for more concentrated solutions to concentrated commercial grade use laminate film material, neoprene, or polyvinyl chloride gloves. If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use. Clothing: Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear an acid resistant apron when handling the chemical as supplied in the reagent bottle or when there is the potential for splashing.	Using procedure 1 above, dilute the acid as needed into desired solvent. Add acid in a fume hood to reaction via pipettor or burette. Double check that the reaction does not need to be cooled first before acid-catalyzed reaction commences. Make sure that solvent is compatible with the acid. Proceed with reaction, ensuring that all components are safe to use with the acid. When finished, neutralize any remaining acid and dispose of waste following appropriate procedures.
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
5. Preparation of <i>aqua regia</i> solution.	Up to 200 mL total solution. Mixture of nitric acid and hydrochloric acid, optimally in a molar ratio of 1:3. Remember to obtain PI approval if higher scale is necessary.	All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.	Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. Face Protection: Face shields are to be used when there is no protection from the hood sash. Hand protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Gloves must be inspected prior to use. Wear chemical-resistant gloves (18 mil neoprene, Silver Shield, or any other glove rated to protect against hydrochloric AND nitric acid). If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use. Clothing: Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear an acid resistant apron when handling the chemical as supplied in the reagent bottle or when there is the potential for splashing.	Mixing nitric acid and hydrochloric acid results in copious fumes and generates heat. Keep the fume hood sash low and mark clearly that <i>aqua regia</i> is in use. The primary hazard from storage of <i>aqua regia</i> is the potential for gas generation and over-pressurization of the container when the solution is still hot. Therefore, it must be left in an open container in order to cool down to room temperature then can be transferred to a closed glass container for waste pickup. Aliquots of each acid must be transferred from primary bottles to separate graduated cylinders or beakers. Transfer required amount of hydrochloric acid to a glass (preferably Pyrex) container. Add required amount of nitric acid. Swirl gently to mix. Do all work with <i>aqua regia</i> solution in the fume hood.
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
<p>6. Sulfuric acid is used to prepare a Piranha solution to clean glass slides.</p>	<p>Up to 200 mL concentrate d sulfuric acid per solution.</p> <p>Piranha solution is 3 parts sulfuric acid to 1 part hydrogen peroxide.</p> <p>Confirm maximum for your lab.</p> <p>Hydrogen peroxide SOP must be included in group SOPs.</p> <p style="color: red;">Remember to obtain PI approval if higher scale is necessary.</p>	<p>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.</p>	<p>Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.</p> <p>Face protection: Wear a face shield <u>AT ALL TIMES</u> when preparing a Piranha solution</p> <p>Hand protection: Wear heavy rubber gloves when working with Piranha solutions. If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed and close-heeled shoes. <u>Wear long sleeves acid resistant apron when preparing and handling piranha solutions.</u></p>	<p>The dilution of sulfuric acid in the piranha solution preparation is highly exothermic; boiling and splashing can result. Always put safety sash in between yourself and the solution when mixing.</p> <p>Clear other chemicals and things that may ignite or react with any splatter from the fume hood prior to beginning.</p> <p>Mixture must be prepared in glass container. Do not cap the hot solution. Do not leave it unattended.</p> <p>Just mixing sulfuric acid with H₂O₂ solutions will heat the solution to over 100°C. Use a tall glass container, and don't fill up very high) so the corrosive fizz doesn't get spill over. Always add acid slowly to the hydrogen peroxide component. Do not add the hydrogen peroxide to the acid.</p> <p>Glassware must be secured standing or in a stand before mixing liquids since containers most likely will become too hot to hold.</p> <p>Never store an actively mixed piranha solution. It must be properly neutralized to within a pH of 5-11 and disposed of in a glass bottle with a vented cap. Always prepare fresh solution.</p> <p>If active solution is spilled, neutralize immediately and collect with absorbent materials. Spill kit must be available within the lab area.</p>
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
7. Cleaning glassware with Piranha solution.	Up to 200 mL of Piranha solution. Remember to obtain PI approval if higher scale is necessary.	All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Or in an inert atmosphere glovebox.	<p>Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.</p> <p>Face protection: Wear a face shield <u>AT ALL TIMES</u> when handling Piranha solution.</p> <p>Hand protection: Wear heavy rubber gloves when working with Piranha solutions. If the acid at any time contacts the gloves being worn, change the gloves immediately. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed and close-heeled shoes. <u>Wear long sleeves acid resistant apron when pouring piranha solution.</u></p>	<p>Clear other chemicals and things that may ignite or react with any splatter from the fume hood prior to beginning.</p> <ol style="list-style-type: none"> Only use on glassware that has already been cleaned using normal procedures. Only use glass containers (preferably Pyrex) for the mixture at all times – also for waste disposal. The mixture is to be made fresh and in minimal quantities to be used and disposed of same day. The solution must be mixed and kept in a fume hood and be well labeled at all times since mixing with further acid, base or organic matter may lead to explosion and water will further increase the vigorous reaction. The reaction is immediate upon mixing with vigorous boiling and heat development. Therefore glass must be used and be secured standing or in a stand before mixing liquids, since containers most likely will become too hot to hold. Although it is not typically necessary to heat the solution, it is OK to heat up to 130°C for full cleaning power. This is a strong oxidizing solution, so have a means of safely immersing and removing the sample to be cleaned. Safe immersion/removing tools are, for example, a glass basket and Teflon tweezers.



Corrosives – Strong Acids

Chemical Class Standard Operating Procedure

Berkeley **EH&S**

				<ol style="list-style-type: none"> 6. Always wash, rinse and dry any glassware before treating with piranha solution. 7. Never store piranha solution and never place warm solution in closed container. 8. After use, leave the piranha solution in a clearly labeled, open container in the fume-hood overnight. A warm solution is still developing gas and if contained, may cause explosion due to over pressurizing. Once cold, the solution can be transferred to a glass bottle with a vented cap, labeled for waste and with content. Make sure to label clearly that no other solution or solid can be added to this bottle due to explosion risk.
Notes	Any deviation from this SOP requires approval from PI.			



List of Chemicals

Chemical(s)	Chemical(s)	Chemical(s)
hydrogen bromide	hydrogen chloride	hydrogen chloride, 0.2 mol/l in Diethyl ether
hydrogen chloride, 0.4 mol/l in dioxane	hydrogen chloride, 4N in 1,4-dioxane	nitric acid
phosphoric acid	sulfuric acid	chloromethanesulfonyl chloride