**Corrosives**

**STANDARD OPERATING PROCEDURE (SOP)**

**Type of SOP:** ☐ Process ☐ Hazardous Chemical ☒ Hazardous Class

**All personnel subject to these SOP requirements must review a completed SOP and sign the associated training record. Completed SOPs must be kept in the laboratory’s safety binder or be otherwise readily accessible to laboratory personnel. Electronic access is acceptable. SOPs must be reviewed, and revised where needed, as described in the** [**SJSU Chemical Hygiene Plan**](https://www.sjsu.edu/fdo/departments/ehs/lab/Chemical_Hygiene_Plan.pdf)**. Note that not all hazardous chemicals are appropriately addressed in a single Hazard Class SOP, and some chemicals are subject to several Hazard Class SOPs.**

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| Date SOP Written:  |  |  | Approval Date: |  |
| SOP Prepared by: | **REQUIRED - Insert Preparer's Name** |
| SOP Reviewed and Approved by (name/signature): | **REQUIRED - Insert Approver's Name & Signature** |
| Department:  | **REQUIRED - Insert Department** |
| Principal Investigator/Laboratory Supervisor:  | **REQUIRED - Insert Name** | Phone:  | **REQUIRED - Insert Phone#** |
| Emergency Contact(s):  | **REQUIRED - Insert Name** | Phone:  | **REQUIRED - Insert Phone#** |
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| Location(s) covered by SOP: | Building: | **REQUIRED - Insert Name** | Lab Phone: | **REQUIRED - Insert Phone#** |
| Room #(s):  | **REQUIRED - Insert Number** |

1. **HAZARD OVERVIEW**

Corrosive substances cause immediate destruction of living tissue and other materials (e.g. metals) by chemical action at the site of contact and can be solids, liquids, or gases. Corrosives are most hazardous to the eyes, as direct exposure may cause blindness in a matter of seconds. Corrosive gases can damage the lining of the lungs leading to pulmonary edema. Dust from Corrosive solids or aerosolized/evaporated liquids can be inhaled and cause serious damage to the respiratory tract.

1. **HAZARDOUS CHEMICAL(S)/CLASS OF HAZARDOUS CHEMICAL(S)**

Most Corrosives fit under the categories of strong/oxidizing, concentrated organic acids, and strong bases.

1. Strong/Oxidizing Acids

Most strong acids are liquids and are most likely to cause immediate pain when they come in contact with the body.

* Examples: Nitric Acid (70 %) and Hydrochloric Acid
1. Concentrated Organic Acids:
* Examples: Formic acid and Acetic acid (glacial)
1. Strong Bases

Solid bases, when dissolved in water, can cause serious damage to eyes and skin by their corrosive action. Fine dust from almost any solid base can cause severe damage to the eyes, upper respiratory tract, and lungs. Fine dust can also cause skin irritation, particularly to damp skin. Contact with strong bases usually goes unnoticed as immediate pain does not always occur. This allows the base time to react with the body part and serious injury may result.

* Examples: Potassium and Sodium Hydroxide
1. Other Corrosives

These materials vary widely and a chemical-specific SDS should be consulted prior to use. In case of exposure, the seriousness of the injury depends on the type and concentration of the chemical, the body parts contacted, and the duration of exposure.

Bromine, hydrogen peroxide (>30%), and most amines are examples of highly corrosive liquids. Examples of common corrosive solids include phosphorus and alkali metals. Strong dehydrating agents, such as phosphorus pentoxide and calcium oxide, have a powerful affinity for water and can cause serious burns upon contact with skin.

* Examples: Phenol, dehydrating agents, and metal halides

**REQUIRED:** List (or attach) the applicable chemical(s) for your laboratory, and describe important properties and signs/symptoms of exposure. The chemical’s Safety Data Sheet (SDS) and [PubChem](https://pubchem.ncbi.nlm.nih.gov/)’s Laboratory Chemical Safety Sheet (LCSS) are excellent sources for this information.

1. **ENGINEERING/VENTILATION CONTROLS**

The following is a general plan for all strong Corrosives:

1. All work should be done in a certified chemical fume hood;
2. Using Corrosives at elevated temperatures (e.g*.* perchloric, nitric, piranha solution) requires facility-specific engineering/ventilation controls. Contact the ehs@sjsu.edu for details; and
3. Chemical dispensers should be considered to reduce potential exposures.

**REQUIRED:** Describe the lab-specific engineering or ventilation controls and equipment safety features (if applicable) that will be used to reduce the risk of chemical exposures to Corrosives.

1. **ADMINISTRATIVE CONTROLS**

The following elements are required:

1. Complete laboratory safety training prior to working in the laboratory;
2. Complete laboratory-specific safety orientation and training on laboratory-specific safety equipment, procedures, and techniques to be used, including the location of laboratory safety equipment (emergency eyewash, safety shower, fire extinguisher);
3. Demonstrate competency to perform the procedures described in this SOP to the Principal Investigator (PI) or trainer;
4. Be familiar with the location and content of any Safety Data Sheets (SDSs) for the chemicals used (online SDSs are available from [MSDS online](https://msdsmanagement.msdsonline.com/8511b604-100d-449a-9a6b-366eff19da04/ebinder/?nas=True));
5. Inspect all equipment and experimental setups prior to use;
6. Follow best practices for the movement, handling, and storage of hazardous chemicals (see Chapters 5 and 6 of [Prudent Practices in the Laboratory](http://ucanr.edu/sites/ucehs/files/133892.pdf) for more detail). An appropriate spill cleanup kit must be located in the laboratory. Chemical and hazardous waste storage must follow an appropriate segregation scheme and include appropriate labeling. Hazardous chemical waste must be properly labelled, stored in closed containers, in secondary containment, and in a designated location;
7. Do not deviate from the instructions described in this SOP without prior discussion and approval from the PI; and
8. Notify the PI of any accidents, incidents, near-misses, or unexpected outcomes involving the Corrosives described in this SOP.

**For Corrosives, the following are also required:**

1. Use a bottle carrier when transporting Corrosives between work areas;
2. Strong Corrosives must only be used in a room with a properly functioning eye wash. A safety shower must be available within 10 seconds of travel;
3. Except in specific procedures (e.g. making Piranha solution), add acid to water to prevent splashing from sudden boiling;
4. Additional considerations are required for certain, particularly dangerous Corrosive materials (e.g. acid/base baths, hot perchloric acid, fuming nitric acid, hydrofluoric acid, aqua regia, Piranha solution, etc.). A chemical-specific SOP should be developed for the use of these materials. Consult the Chemical Hygiene Officer for advice; and
5. Due to the corrosive properties of these materials and their ability to produce fires or explosions in combination with combustible and other incompatible materials, Corrosives should be:
	1. Stored in a manner that separates acids/bases from each other and other materials;
	2. Stored in a manner that is consistent with their properties;
	3. Stored in a container that is corrosion-resistant, and in secondary containment that facilitates flushing and other cleanup procedures in the event of leaks or spills;
	4. Stored on shelves below eye level or in corrosion-resistant acid/base storage cabinets. Epoxy-painted wood or plastic laminate construction with plastic shelves are optimal; and
	5. Segregated from incompatible materials, such as:
* Oxidizing acids from organic acids and flammable/combustible materials;
* Acids from active metals such as sodium, potassium, magnesium, etc.; and
* Strong bases from glass.

**REQUIRED:** Insert the laboratory-specific restrictions on maximum quantities to be used or stored, including any special handling or storage requirements.

**INSERT IF APPLICABLE:** Describe any additional administrative controls (e.g. restrictions on working alone/procedure/work equipment/work locations/unattended operations). Include any chemical-specific administrative controls (e.g. peroxide formers).

1. **PERSONAL PROTECTIVE EQUIPMENT (PPE)**

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory or technical area where hazardous chemicals are used or stored.

In addition to the minimum attire required upon entering a laboratory, the following PPE is required for work with Corrosives:

1. **Eye Protection** (must be ANSI Z87.1-compliant)**:**
	1. At a minimum safety glasses are required.
	2. Splash goggles may be substituted for safety glasses, and are required for processes where splashes are foreseeable or when generating aerosols.
	3. Ordinary prescription glasses are not acceptable eye protection and cannot be used in lieu of proper safety eyewear.
	4. Depending on the hazard assessment, a face shield may be required and be worn over safety eyewear.
2. **Body Protection**: At a minimum a chemically-compatible laboratory coat that fully extends to the wrist is necessary. A chemically-compatible lab coat may be substituted for other types of body protection (e.g. apron, disposable sleeves, etc.) so long as the substituted protection provides similar or better protection to the researcher.
	1. A [video from UCSD](https://www.youtube.com/watch?v=a6DrCdjedas#t=11) highlights the importance of wearing proper PPE when using Corrosives.
	2. For chemicals that are corrosive and/or toxic by skin contact/absorption additional protective clothing (e.g. face shield, chemically-resistant apron, disposable sleeves, etc.) are required where splashes or skin contact is foreseeable.
3. **Hand Protection**: Hand protection is needed for the activities described in this SOP. Define the type of glove to be used based on:
	1. The chemical(s) being used;
	2. The anticipated chemical contact (e.g. incidental, immersion, etc.);
	3. The manufacturers’ permeation/compatibility data; and
	4. Whether a combination of different gloves is needed for a specific procedural step/task.

**REQUIRED:** Insert lab-specific descriptions of PPE and hygiene practices used with Corrosives, including any specialized PPE needed for a procedural step or specific task.

1. **SPILL AND EMERGENCY PROCEDURES**

Do not attempt to clean up a chemical spill unless you have been trained and feel comfortable doing so. Contact the College Safety Team or Environmental Health & Safety (EH&S), for help with cleaning up a small chemical spill. For a large spill of Corrosives, confine the spill within the fume hood or room, evacuate everyone from the lab, and call 911 (or 408-924-2222 from a non-campus phone).

For solid base contact, quickly and carefully wipe off dry solid before rinsing exposed body parts. Use care to not disperse base particles into the air.

**REQUIRED:** Insert description of who to call in case of Corrosives spill in the lab.

1. **WASTE MANAGEMENT AND DECONTAMINATION**

**Waste Management:**

Hazardous waste must be managed as outlined in [SJSU’s Chemical Hygiene Plan](https://www.sjsu.edu/fdo/departments/ehs/lab/Chemical_Hygiene_Plan.pdf), and must be [properly labeled](http://www.science.sjsu.edu/safety/HazWasteForm.pdf). In general, hazardous waste must be removed from your laboratory within nine months of the accumulation start date.

Extreme care must be used when managing oxidizing acid waste streams (e.g. nitric acid, Piranha solution, perchloric acid). Addition of organic material—from solvent, reagents, or a dirty waste container—to the oxidizing acid will produce large volumes of gas, and cause the container to catastrophically rupture. Never cap waste container if the contents are actively reacting.

**REQUIRED:** Insert descriptions of laboratory-specific information on the waste streams generated, storage location, and any special handling/storage requirements.

**Decontamination:**

Decontamination procedures vary depending on the material being handled. Carefully inspect work areas to make sure no hazardous materials remain. Following dispensing or handling, all surfaces and equipment should be wiped with the appropriate cleaning agent to prevent accumulation of Corrosive chemical residue. Dispose of cleaning materials properly. Decontaminate vacuum pumps or other contaminated equipment before removing them from the regulated area.

**REQUIRED:** Insert description(s) of decontamination procedures for equipment, glassware, and/or controlled areas (e.g. gloveboxes, restricted access hoods, or designated portions of the laboratory).

Upon completion of work with Corrosives and/or decontamination of equipment, remove gloves and wash hands with soap and water. Upon leaving the laboratory or designated Corrosives work area, remove all PPE worn and wash hands and forearms as needed. Contaminated PPE should not be worn outside of the laboratory. Soiled lab coats should be sent for professional laundering. Grossly contaminated clothing/PPE, and disposable gloves must not be reused and should be disposed of as hazardous waste.

1. **DESIGNATED AREA**

Designated area(s) for the use and storage of Corrosives should be established where limited access, special procedures, knowledge, and work skills are required. Signage indicating the corresponding [Globally Harmonized System (GHS) pictogram(s)](https://www.osha.gov/Publications/HazComm_QuickCard_Pictogram.html) should be visible at the entrance of the designated area (e.g. postings on the exterior of the laboratory door).

**REQUIRED:** Insert description(s) of the designated area(s) for Corrosives in your laboratory. The entire laboratory, a portion of the laboratory, a fume hood, etc. can be designated.

1. **DETAILED PROTOCOL**

**REQUIRED:** Insert the lab-specific protocol for the process, hazardous chemical(s), or hazard class described in this SOP. Include any relevant resources such as journal articles, patents, etc. as desired.

**TEMPLATE REVISION HISTORY**

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| --- | --- | --- | --- |
| **Version** | **Date Implemented** | **Author** | **Revision Notes:** |
| **1.0** | **6/22/2021** | **Alexi Ball-Jones** | **New template** |
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**LAB-SPECIFIC REVISION HISTORY**

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| **Version** | **Date Approved** | **Author** | **Revision Notes:** |
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**Documentation of Standard Operating Procedure Training**

*(Signature of all users is required)*

* Prior to using **Corrosives**, laboratory personnel must be trained on the hazards described in this SOP, how to protect themselves from these hazards, and emergency procedures.
* Ready access to this SOP and to a Safety Data Sheet for each hazardous material described in the SOP must be made available.
* The Principal Investigator (PI), or the Laboratory Supervisor if the activity does not involve a PI, must ensure that their laboratory personnel have attended appropriate laboratory safety training or refresher training within the last three years.
* Training must be repeated following **any** revision to the content of this SOP. Training must be documented. This training sheet is provided as one option; other forms of training documentation (including electronic) are acceptable but records must be accessible and immediately available upon request.

**Designated Trainer:** *(signature is required)*

I have read and acknowledge the contents, requirements, and responsibilities outlined in this SOP:

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| --- | --- | --- | --- |
| **Name** | **Signature** | **Trainer Initials** | **Date** |
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