**University of Arizona**

**Perchloric acid Standard Operating Procedure**

*[This is a template. Fill in all necessary blanks and delete all highlighted areas when complete. Add any sections necessary for your laboratory. This will be appended to your Laboratory Chemical Hygiene Plan.]*

**Title:**  **Click here to enter the title of your SOP.**

**Approval Holder (AH):** Click here to enter text **Approval #:** Click here to enter text

**Approval Holder Phone Number(s):** Click here to enter text

**Approval Safety Coordinator (ASC):** Click here to enter text

**Approval Safety Coordinator Phone Number(s):** Click here to enter text

**Department:** Click here to enter text

1. **Purpose**

This standard operating procedure (SOP) is intended to provide guidance on how to safely use, store, and disposae of perchloric acid in Enter AH’s name’s laboratory. Laboratory personnel should review this SOP, as well as the appropriate Safety Data Sheet(s) (SDSs), before Describe the procedure or process this SOP will address. If you have questions concerning the requirements within this SOP, contact your Approval Holder (AH) or Approval Safety Coordinator (ASC).

1. **Scope**

*[Describe when this SOP applies and to whom this SOP applies.]*

1. **Hazard Description**

*[Describe the hazards presented by the procedure or process this SOP addresses. What makes it hazardous? Provide an example, if applicable.]*



* Perchloric acid is one of the strongest acids known. At room temperature, aqueous solutions up to 72% do not have significant oxidizing power, and the corrosive properties are very similar to other mineral acids. However, the oxidizing power increases with concentration and temperature. Concentrated perchloric acid (72%) heated above 150⁰C is a strong oxidizer, and reacts violently with organic material, which has resulted in devastating explosions in the past.
* The monohydrate of perchloric acid (85%) is a good oxidizer at room temperature.
* Anhydrous perchloric acid is highly unstable, explodes upon contact with organic material, and explodes spontaneously at room temperature after storage for a few days. Its preparation should be avoided.
* Perchloric acid forms an azeotrope with water at a concentration of 72.5% perchloric acid. Therefore, aqueous solutions do not form anhydrous perchloric acid by evaporation. However, dangerous anhydrous perchloric acid can form when an aqueous solution is subjected to strong dehydrating conditions such as exposure to concentrated sulfuric acid, acetic anhydride, or phosphorous pentoxide.
* At elevated temperatures, vapors from perchloric acid can condense on surfaces in the ductwork of the hood, where they form perchlorate salts that are often highly shock-sensitive and that pose a serious explosion hazard.
* Perchloric acid reacts with alcohols and certain other organic compounds to form highly unstable and explosive perchlorate esters.

1. **Process & Hazard Controls**

*[Describe the steps needed to set up and complete the procedure or process in safe manner following the* [*hierarchy of controls*](https://www.cdc.gov/niosh/topics/hierarchy/default.html)*. Use as much detail as is necessary to ensure all laboratory workers can complete the procedure or experiment safely.]*

* 1. **Elimination/Substitution**

*[Describe any eliminations of hazardous chemicals or processes; alternatively, any substitutions with less hazardous alternatives that could be used to accomplish the task. Delete this section if you are unable to eliminate or substitute.]*

* 1. **Engineering Controls**

*[Describe any engineering controls (e.g. fume hoods, gas cabinets, local exhausts, blast shields, etc.) that are used to safely accomplish the task.]*

* **Fume hood**: Perchloric acid solutions should only be made and used within a fume hood. Do not head perchloric acid solutions unless you have the use of a specialty perchloric acid fume hood with a duct wash system.
  1. **Work Practices**

*[Describe any work practices (e.g. staggering schedules, additional cleaning measures for particulates, etc.) that are used to safely accomplish the task.]*

* **Dilute by adding perchloric acid to water, not by adding water to acid.**
* Do not handle perchloric acid on a wooden surface, and do not let it come into contact with oxidizable materials such as cloths, paper towels, or grease. Such materials can become highly flammable and may ignite spontaneously or even explode after absorbing perchloric acid liquid or vapor.
* Do not subject perchloric acid to strong dehydrating conditions.
* If solutions containing perchloric acid are filtered through a paper filter, the filter (and precipitate) should be washed thoroughly with water to remove all perchlorate before being allowed to dry.
* Do NOT mix concentrated perchloric acid (>72%) with organic chemicals if temperatures could rise above ambient levels.
* Do not heat perchloric acid in an oil bath. Use a sand bath, a heating mantle, or a hot plate.
* Do not expose concentrated perchloric acid to strong dehydrating conditions, such as exposure to sulfuric acid, acetic anhydride and phosphorous pentoxide.
* Dilute by adding perchloric acid to aqueous solution, do not add aqueous solution to concentrated perchloric acid. Do not subject perchloric acid to strong dehydrating conditions.
* Do NOT mix concentrated perchloric acid (>72%) with organic chemicals if temperatures could rise above ambient levels.
  1. **Personal Protective Equipment**

*[Describe the personal protective equipment needed to adequately protect laboratory workers when performing the process or procedure addressed by this SOP. Ensure to specify any personal protective equipment beyond the minimum (i.e. safety glasses, lab coat, gloves, long pants and closed-toed shoes).]*

* **Hand and Arm Protection**: Elbow-length, acid resistant gloves should always be used when creating, working with, or cleaning up.
* **Face and Eye Protection**: Safety goggles are a minimum protection; the use of a face shield with eye protection is strongly recommended to protect both the eyes and face from splashes.
* **Body Protection**: A 100% cotton lab coat should be used and can be combined with an acid resistant apron to prevent exposure to the body.
* **Respiratory Protection**: Respirators may be required if exposures are not able to be adequately controlled by the use of engineering controls or other means. All uses of respiratory protection require RLSS assessment and consultation (for assessment of work, selection of respirator and filtration, and OSHA-mandated medical clearance and fit testing). Contact [rlss-ppe@arizona.edu](mailto:rlss-ppe@arizona.edu) with any questions or concerns.
  1. **Transportation and Storage**

*[Describe how to safely transport and/or store (e.g. ventilated cabinet, flammable cabinet, under inert blanket, etc.) the hazardous chemical(s) or processes.]*

**Transport**

* When transporting small volumes of perchloric acid, ensure the container is stored in a leak proof, hard sided container with absorbent material (NOT paper towels or other items that could spontaneously catch fire).
* Do not use personal vehicles for transport; use a state vehicle or walk/push with a cart that has anti-roll lip between locations.
  + If walking, wear PPE while transporting and be sure to bring spill clean up materials. Avoid high traffic areas in the event of an unplanned release.

**Storage**

* Limit stored quantities to what is needed for the next 6-12 months; do not store perchloric acid over extended periods of time.
* Inspect perchloric acid solutions, at a minimum, monthly for discoloration and/or formation of white precipitates. If discolored and/or precipitates are found, dispose immediately.
* Never store perchloric acid on a wooden shelf or in areas with paper; store in a secondary container made of plastic, glass, ceramic, or another non-porous/combustible material on a non-porous/flammable shelf.
* Store perchloric acid with other inorganic acids and away from organic chemicals and reducers, especially alcohols, glycerol, and hypophosphites.
  + Perchloric acid must not be stored amongst any of the following compounds/chemicals: Acetic acid, Acetic anhydride, Alcohols, Aniline, Antimony compounds (trivalent), Bismuth, Dehydrating agents, Diethyl ether, Formaldehyde mixtures, Fluorine, Glycerine, Glycols, Glycol ethers, Hydriodic acid, Hydrochloric acid, Hypophosphites, Ketones, Lead oxide mixtures, Nitrogen triiodide, Nitrosophenol, Organic matter (e.g. paper, wood, charcoal, rags, cotton, etc.), Sodium iodide, Sulfoxides and Sulfur trioxide.

1. **Spills, Cleanup & Disposal**

*[Describe how to safely end the procedure or process, clean up the process or spills, and/or dispose of any waste generated.]*

**Spills**

* Spills of perchloric acid must be cleaned up thoroughly; dried acid residues can cause unexpected explosions in the future.
* The spill should be neutralized immediately with sodium bicarbonate or other inorganic acid neutralizer. Sweep up the neutralized spill with a non-flammable material and then clean the spill area thoroughly with water.
* Do NOT use rags, paper towels, or sawdust to soak up perchloric acid spills. Such materials may spontaneously ignite once dried out. Likewise, spills on wood may present a fire hazard after the liquid dries.
* In the event of a fire, the best extinguishing agent is water. Call 9/11 as soon as possible.
* For large spills, evacuate and call 9/11 and, when practicable, RLSS (520-626-6850).

Spill response should always follow the [University Chemical Hygiene Plan](https://rgw.arizona.edu/sites/default/files/cs-univeristy_chemical_hygiene_plan.pdf) Section 8.2.

**Exposure Response**

|  |  |  |  |
| --- | --- | --- | --- |
| **Inhalation** | **Ingestion** | **Skin Contact** | **Eye Contact** |
| If not breathing, give artificial respiration. Remove from exposure, lie down. Do not use  mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration  with the aid of a pocket mask equipped with a one-way valve or other proper respiratory  medical device. Call a physician immediately. | Do not induce vomiting. Clean mouth with water. Never give anything by mouth to an  unconscious person. Call a physician immediately. | Wash off immediately with plenty of water for at least 15 minutes. Remove and wash  contaminated clothing before re-use. Call a physician immediately. | Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.  Immediate medical attention is required. |

**Disposal**

* Dispose of bottles with discolored perchloric acid solutions immediately.

1. **Additional Precautions**

*[Add as many sections as necessary to adequately describe how to safely perform the procedure or process addressed by this SOP.]*

* If you know of or suspect that perchloric acid digestions have been performed in a fume hood not specifically designed for perchloric acid, inform RLSS as soon as possible and prevent users from working in the hood.

1. **References**

* UCLA Perchloric Acid SOP: <https://ucla.box.com/s/ushkrni7obl0fcpyea55me1ayloww42q>