**UH Guideline for Perchloric Acid**

**Introduction**

Perchloric acid is a strong mineral acid commonly used as a laboratory reagent. It is a clear, colorless liquid with no odor. The University of Houston discourages work with perchloric acid of concentrations greater than 60% without proper engineering controls. However, specific chemical reactions and research protocols may require higher concentrations of perchloric acid. If so, your lab-specific SOP must be approved by EHS prior to procurement. No one should ever work with perchloric acid alone. This particular guideline was created by the Department of Environmental Health and Safety with the goal of complying with 29 CFR 1910.1450 (e)(3)(i) and educating the campus community in the safe use of perchloric acid.

**Purpose and Scope**

This policy present information on how to handle and store perchloric acid safely. All UH Laboratory Personnel who work in labs containing perchloric acid must familiarize themselves with this document. A copy of the signature page, the last page of this document, must be kept by the PI and Designee acknowledging Laboratory Personnel have read this document and are aware of the unique dangers and precautions that must be taken when handling this acid.

**Overview of Hazards**

Under some circumstances perchloric acid may act as an oxidizer and/or present an explosion hazard. Organic materials are especially susceptible to spontaneous combustion if mixed or in contact with perchloric acid. Under some circumstances, perchloric acid vapors form perchlorates in duct work, which are shock sensitive.

Perchloric acid can be a health hazard if inhaled, ingested or splashed on skin or in eyes. To prevent injury, goggles or a face shield over safety glasses, gloves and an apron over lab coat, must be worn when handling perchloric acid. Symptoms of overexposure include irritation and/or burning of the affected area. Inhalation burns are serious and require immediate

medical attention. If perchloric acid is ingested, drink approximately 8 oz. of water and seek medical attention immediately. Do not induce vomiting.

**Because of its reactivity hazard, perchloric acid digestions of any size shall always be conducted in a special perchloric acid hood that is equipped with a wash down system.** Hoods used for hot digestions must be labeled “Perchloric Acid Hood Only. Organic Chemicals Prohibited.” Solvents must never be used or stored in a designated perchloric acid hood. **Currently, there are no active perchloric acid hoods available on the University of Houston campus. If your lab intends to perform perchloric acid digestions, EHS must be contacted prior to procurement.**

**Using Perchloric Acid (<72%) at Room Temperature**

At room temperature, perchloric acid up to concentrations of 72% has properties similar to other strong mineral acids. It is a highly corrosive substance that causes severe burns on contact with the eyes, skin, and mucous membranes. When used under these conditions, perchloric acid reacts as a strong non-oxidizing acid. The following precautions must be taken when using perchloric acid under these conditions:

* Substitute with less hazardous chemicals when appropriate. Use dilute solutions (<60%) whenever possible.
* Conduct operations involving cold perchloric acid in a properly functioning chemical fume hood with current EHS certification. However, perchloric acid reactions performed with higher concentrations or that involve heat must be used in a designate perchloric acid fume hood.
* Always use impact-resistant chemical goggles, a face shield, neoprene gloves, and a rubber apron when handling perchloric acid.
* When using or storing even dilute perchloric acid solutions avoid contact with strong dehydrating agents (concentrated sulfuric acid, anhydrous phosphorous pentoxide, etc.). These chemicals may concentrate the perchloric acid and make it unstable.
* Always transfer perchloric acid over a sink or other suitable containment in order to catch any spills and afford a ready means of cleanup and disposal.
* Perform all operations on chemically resistant surfaces. Avoid contact with cellulose materials such as wood, paper and cotton. Perchloric acid may become concentrated and cause a fire or explosion.

**Using Heated Perchloric Acid (<72%)**

**Perchloric acid digestions and other procedures performed at elevated temperatures must be done in a specially designed perchloric acid fume hoods. There are no active perchloric acid hood available on the University of Houston campus. If your lab intends to perform perchloric acid digestions, EHS must be contacted prior to procurement.**

When heated to temperatures above 150° C perchloric acid (<72% concentration) becomes a strong oxidizer and eventually becomes unstable. Concentrated solutions are very dangerous and can react violently with many oxidizable substances, such as paper and wood, and can detonate. Vapors may also contaminate work surfaces or ventilation equipment with perchlorate residues, which may form highly unstable compounds, such as metallic perchlorates. These compounds may ignite or detonate under certain conditions.

The following additional precautions shall be followed when heating perchloric acid:

* Lower the fume hood sash as much as possible so that it can function as a physical barrier or use a safety shield to provide splash/splinter protection. Perchloric acid fume hoods must have shatterproof glass.
* Never heat perchloric acid in an oil bath or with an open flame. Electric hot plates, electrically or steam-heated sand baths, heating mantles, or steam baths are preferred. Use explosion proof electrical equipment.
* Avoid allowing hot perchloric acid to come into contact with any organic materials, including paper or wood, because a fire or explosion can occur. Avoid storing these materials in perchloric acid work hoods. Avoid using greases or hoses that are incompatible with perchloric acid.
* Be sure to understand the reaction(s) that can occur when using perchloric acid. Perchloric acid may react violently with many chemicals, including acetic anhydride, alcohol, reducing agents, and many metals.
* In wet digestions with perchloric acid, treat the sample first with nitric acid to destroy easily oxidizable matter.
* Do not distill perchloric acid in a vacuum, because the unstable anhydride may be formed and cause a spontaneous explosion. Protect vacuum sources from perchloric acid/perchlorate contamination. Vacuum pumps must be thoroughly flushed and refilled with Kel-F or Fluorolube.
* Wash down perchloric acid hoods after each use, following operating instructions provided by the manufacturer of the perchloric acid hood.

**Anhydrous Perchloric Acid**

**Use Anhydrous Perchloric Acid in a designated, properly designed perchloric acid hood with a minimum of equipment present. No extraneous chemicals shall be present in the hood. There are no active perchloric acid hoods available on the University of Houston campus. If your lab intends to perform perchloric acid digestions, EHS must be contacted prior to procurement.**

Anhydrous perchloric acid (> 85% concentration) is very unstable and can explode when it comes in contact with organic materials. Follow these additional precautions when working with anhydrous perchloric acid.

Allow only authorized experienced Laboratory Personnel to handle anhydrous perchloric acid. These Laboratory Personnel shall be thoroughly familiar with the literature on the acid, this policy, Chemical hygiene plan and Dress Code Policy. Assure that a second worker is informed of the intended use of the anhydrous perchloric acid. This second worker must be in sound or sight contact with the worker using anhydrous perchloric acid. No one shall ever work alone with anhydrous perchloric acid.

Use a safety blast shield to protect oneself against the effects of an explosion. Use thick gauntlets in addition to PPE previously recommended. Use only freshly prepared acid. Do not make any more anhydrous perchloric acid than is required for a day/shift.

**Perchloric Acid Storage**

The quantities of perchloric acid kept in storage must be kept to **a minimum.** Perchloric acid must be stored in its original container within compatible secondary containment, preferably glass or porcelain. Perchloric acid bottle shall be properly labelled as mentioned, section 4.5 - Labelling and Signage, in the UH Chemical Hygiene Plan.

Perchloric acid must be separate from other chemicals, but may be stored with other inorganic acids, preferably in a metal cabinet designed for acid/corrosive storage. Perchloric acid must be stored away from organic chemicals, flammable materials and strong dehydrating agents such as sulfuric acid and anhydrous phosphorus pentoxide.

If a bottle containing perchloric acid has turned dark and has crystals forming around the bottom of the bottle, there is a potential explosion hazard. **Do NOT move the bottle. Immediately contact EHS.**

**Perchloric Acid Spills**

CLEAN UP SPILLS OF PERCHLORIC ACID ONLY IF YOU HAVE BEEN TRAINED TO DO SO AND THE APPROPRIATE EQUIPMENT IS AVAILABLE! If you need advice, call EHS.

To clean a spill, neutralize it with soda ash (sodium carbonate) or other appropriate neutralizing agent. Soak up the neutralized spill with an inorganic based absorbent, if possible. Do not use organic materials, such as Kim-wipes or toweling as they may spontaneously ignite upon contact with perchloric acid. If rags or paper towels are in advertently used, wet them with water and place them in a tightly sealed plastic bag. Do NOT use rags, paper towels, or sawdust and then put them aside to dry out, as such materials may spontaneously ignite. A second neutralization and rinsing of the wetted area is recommended.

Perchloric acid waste must not be mixed with other wastes. It shall be placed into acid resistant containers that are clearly labeled and held for disposal.

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| **[Laboratory Name]****Documentation of Training\*****Standard Operating Procedure for Perchloric Acid**  |
| *“I have read and understand this SOP. By signing below, I agree to fully adhere to its requirements.”* |
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\* This document, including the signature page with signatures by all involved personnel shall be maintained by the Principal Investigator or Designee, and be submitted to EHS either electronically via the ehs@uh.edu or hard copy upon request.

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|  **Template Revision History** |
| Version | Date Approved | Author | Revision Notes: |
| 1.0 | 07/01/2019 | EHLS Chemical Safety  | New Template. |
| 1.1 | 06/10/2020 | EHS Chemical Safety | Name & logo change, and review. |
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