



<b>SAFE WORK PROCEDURE</b>	<b>Insert Reference Code: UBC-RMS-OHS-SWP-19-001</b>
<b>Department of Risk Management Services</b> www.rms.ubc.ca	Effective date: April 18, 2019 Review date: NA Supersedes: NA

## Working Safely with Perchloric Acid

### 1. SCOPE

All UBC employees working with and/or handling perchloric acid should follow this safe work procedure. It describes methods to safely handle, use and store perchloric acid.

Perchloric Acid is a strong inorganic acid used for digestions of organic material, plant matter, soils, etc. It is normally supplied at 70-72% concentration in safety coated glass containers in less than one litre capacity.

Certain laboratory procedures may require the use of perchloric acid. Formation of explosive perchlorate crystals can be a by-product of the experiment. Per WorkSafeBC regulations, special fume hoods known as perchloric acid fume hoods MUST be used. The fume hoods have self-contained wash-down units to inhibit crystal formation within the fume hood and the exhaust ductwork.

Work with perchloric acid is regulated by WorkSafe BC [Occupational Health and Safety Regulation 30.21](#).

### 2. RESPONSIBILITY

Supervisors and members of research groups who are using perchloric acid must:

- Keep an inventory of all perchloric acid
- Create and document a risk assessment prior to perchloric acid use
- Purchase, store and use the minimum quantity of perchloric acid possible
- Use designated perchloric acid fume hoods and follow procedures for their use
- Document all required training
- Document and follow the appropriate safe work procedure.

### 3. EDUCATION/TRAINING REQUIRED

- [Chemical Safety Course](#) offered by Risk Management Services
- Read and understand the Perchloric Acid Safety Data Sheet (SDS). Contact Risk Management Services at [researchsafety@rms.ubc.ca](mailto:researchsafety@rms.ubc.ca) or 604-827-3409 if help is needed to locate and/or understand the SDS.



All employees working with perchloric acid must receive appropriate onsite training covering:

- Health effects resulting from exposure to perchloric acid
- Safe work procedures
- Personal protection
- How to clean a perchloric acid spill
- First aid and emergency procedure

#### 4. HAZARD

##### Physical Hazards

Perchloric acid is the inorganic compound with the formula  $\text{HClO}_4$ . Usually encountered as an aqueous solution, this colorless compound is a strong acid comparable in strength to sulfuric acid and nitric acid. It is a powerful oxidizer, but its aqueous solutions up to 70% are remarkably inert, only showing strong acid properties and no other oxidizing properties.

Above concentrations of approx. 70% the speed of oxidizing reactions rapidly increases with increasing acid concentration. The oxidizing power also greatly increases as the temperature is increased. It is useful for preparing perchlorate salts, especially ammonium perchlorate, an important rocket fuel. Perchloric acid is also dangerously corrosive and readily forms explosive mixtures.

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.

##### Health Hazards

The acute toxicity of perchloric acid is moderate to high. It is a highly corrosive substance and causes severe burns on contact with the eyes, skin, and mucous membranes. Liquid or spray mist may produce tissue damage on mucous membranes of the eyes. Inflammation of the eye is characterized by redness, watering, itching and blurred vision. It can also lead to loss of vision or blindness. Skin contact may produce inflammation characterized by itching, reddening and blistering. Inhalation of spray or mist may produce severe respiratory tract irritation, causing sore throat, coughing, labored breathing and even lung edema. Ingestion of perchloric acid will cause mouth, throat, stomach and intestinal tract burns, along with abdominal pain and diarrhea.

Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, and perforation of the nasal septum, chest pains, and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis. Repeated dermal exposure may cause sensitization dermatitis and destruction or ulceration of the skin. Perchloric acid has not been shown to be carcinogenic or to show reproductive or developmental toxicity in humans.



## 5. ENGINEERING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

### Engineering Controls

The use of perchloric acid at concentrations <72% and at normal temperatures should be conducted in a properly functioning chemical fume hood. The chemical fume hood must be certified by UBC RMS (date on the sticker should not be older than a year). Use a specialized perchloric acid fume hood with built in wash down systems and non-reactive metal surfaces when working with concentrations of 72% or above, performing digestions, heating, or mixing with strong dehydrating chemicals (concentrated sulfuric acid, anhydrous phosphorus pentoxide) any concentration of perchloric acid. Perchloric hoods should be washed down every day or more often according to manufacturer's instructions, depending on frequency and type of use. Put a sign on these hoods to distinguish them from other types of hoods and designate the hood as an area where organic chemicals are prohibited. Keep container lids tightly closed whenever possible. **Solvents must never be used or stored in a dedicated perchloric acid fume hood.**

### Personal Protective Equipment

**Hand protection:** Two-sets of chemical-resistant gloves (e.g., nitrile or neoprene) should be worn ("double-gloving"). A heavy-duty glove, such as butyl rubber, Viton, or equivalent, is recommended. Use gauntlet gloves if working with anhydrous perchloric acid.

**Eye protection:** ANSI-approved properly fitting safety glasses or chemical splash goggles are required. A face shield must also be worn.

**Skin and body protection:** Laboratory coats must be worn, appropriately sized for the individual, and buttoned to their full length. A chemical-resistant/rubber apron is also required. Personnel must also wear full length pants, or equivalent, and close-toed shoes. Full length pants and close-toed shoes must be worn at all times by all individuals that are occupying the laboratory area. The area of skin between the shoe and ankle must not be exposed.

**Respiratory protection:** Perchloric acid should never be used outside of a chemical fume hood; however, if perchloric acid must be used outside of a chemical fume hood, respiratory protection may be required. If this activity is necessary, contact [RMS Occupational Hygiene](#).

## 6. GUIDELINES FOR SAFE WORK PRACTICES

### 6.1. Handling

- All operations involving perchloric acid must be performed in a fully functioning chemical fume hood (room temperature, concentration less than 72.5%). For all other cases a wash-down fume hood must be used.



- The fume hood must be in the immediate vicinity of a safety shower and emergency eyewash station.
- Lower the fume hood sash as much as possible so that it can function as a physical barrier and use a safety shield to provide splash protection.
- Dilute only by adding perchloric acid slowly to water while stirring, never add water to perchloric acid.
- Experimental apparatus should utilize glass-to-glass joints. Cork or rubber stoppers and equipment with rubber components must not be used with perchloric acid. Teflon stopcocks have been used safely. In addition, Viton (fluoro elastomer) has satisfactory compatibility and Ethylene-Propylene has fair compatibility. Greases, including silicone types, are not to be used. Fluorocarbon lubricants are recommended.
- 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.
- Do not allow hot perchloric acid to come into contact with any organic materials, including paper or wood and avoid storing these materials in perchloric acid work hoods as fire or explosion can occur.
- Thoroughly rinse all surfaces and lab-ware used in the experiment after each use to remove any residues.

## **6.2. Handling of anhydrous perchloric acid (in addition to 6.1.)**

- Work with anhydrous perchloric acid must never be done alone. A second person must always be in view at all times and must be trained to perform rescue should the need arise.
- Anhydrous perchloric acid may only be used if freshly made and any unused perchloric acid must be disposed of safely at the end of the experiment or procedure but must not be kept for more than one day.
- A safety shield must be used to protect against a possible explosion and the work must be done in a specifically designed fume hood.
- Use thick gauntlets in addition to PPE previously recommended.
- Only freshly prepared acid should be used and only the absolute minimum quantity required for the work should be prepared.
- Dispose of any unused anhydrous perchloric acid at the end of your work via dilution and neutralization (see procedure for a small spill, below).
- If the anhydrous perchloric acid appears discolored, it must be disposed of immediately, via the method indicated below.
- The following materials are not recommended for use with 72% perchloric acid:  
Nylon/polyamides, Dacron/polyester, Bakelite, Lucite, cellulose-based lacquers,



copper/brass/bronze (which form shock sensitive salts), aluminum (dissolves), high nickel alloys (dissolve).

### 6.3. Storage

- No more than 6.4 kg (14 lbs) of perchloric acid may be stored in a laboratory
- Perchloric acid at concentrations above 85% should not be stored in any quantity.
- Minimal quantities of material should be purchased and stored.
- Keep container upright and tightly closed in acid storage cabinet.
- Do not allow the perchloric acid to freeze.
- Containers which are opened must be carefully resealed and kept upright to prevent leakage. Date all opened perchloric acid containers.
- Keep away from sources of ignition. Avoid heat, sparks, shock or friction when handling.
- Do not store under the sink, in wooden cabinets or on paper-lined shelving
- Store in original container and inside proper secondary containment made of glass or porcelain. Perchloric acid should not be stored in metal or plastic containers.
- Crystal Formation: If crystals have formed around the *bottom* of the bottle, there is a potential explosion hazard. DO NOT move the bottle, contact RMS at 604-827-3409 for immediate assistance.
- The outsides of the bottle and any trays used must be rinsed with water when procedures are complete before being stored or disposed of. Note: persons who have picked up bottles that were externally contaminated with perchloric acid have received severe acid burns.

### 6.4. Spills

*Do not attempt to clean up a spill volume larger than 500 ml of perchloric acid – evacuate the lab and contact Risk Management Services (604 822 2029) and/or 911 for assistance*

#### **Perchloric acid spill on an individual**

- Immediately remove contaminated PPE items and/or contaminated clothing. Place contaminated items in a container with water.
- If, during the spill, the skin and/or eye(s) came in contact with perchloric acid, flush contaminated skin with water for at least 15 minutes. During this time call 24444 for first aid.
- Contact ESF at 604-822-6306 for directions concerning disposal of the container and contents.
- Complete UBC Incident/Accident forms on [CAIRS \(Centralized Accident Incident Reporting System\)](#) within 48 hours of the spill.

#### **Perchloric acid spill on equipment or surfaces**

- Alert supervisor and personnel in the immediate area and ask a co-worker to bring the spill kit
- Isolate spill area (caution tape, signage)



- Put on PPE (face shield over safety goggles, disposable gloves, neoprene gloves on top, PVC apron over lab coat, rubber boots – if necessary)
- Neutralize by slowly pouring acid neutralizer (sodium carbonate, Spill X-A, Neutrasorb or equivalent product) from the perimeter of the spill, inward. The quantity of neutralizer will vary with the concentration of the acid.
- **NOTE:** the spill should NOT be whipped up with organic or combustible materials (paper towels, rags, etc) because perchloric acid is incompatible with these materials and when they dry, these materials can spontaneously ignite.
- Use a plastic dustpan/brush to transfer the neutralized slurry to a container of water for disposal. Contact ESF at 604-822-6306 for directions concerning disposal of the container and contents.
- A second neutralization, along with wiping/rinsing down the area with soap and water solution is recommended.
- Complete UBC Incident/Accident forms on [CAIRS \(Centralized Accident Incident Reporting System\)](#) within 48 hours of the spill.

#### 6.5. Waste

- Waste Perchloric Acid should be placed in a chemically compatible container, neutralized and disposed of as [hazardous waste](#)
- Never dispose of Perchloric Acid contaminated material in the trash

#### 7. REVIEW AND RETENTION

This SWP is reviewed annually or whenever deemed necessary by the responsible Risk Management Services representative.

#### 8. DOCUMENT INFORMATION

Written / Reviewed by: RMS Advisor, Chemical Safety  
Contact: [researchsafety@rms.ubc.ca](mailto:researchsafety@rms.ubc.ca)  
604-827-3409