THE CITADEL
SCHOOL OF SCIENCE AND MATHEMATICS

Chemistry Department

Standard Operating Procedures

Print out the completed form and keep a readily accessible hard copy in the lab (also keeping an electronic copy is highly recommended).

Date: 12-7-2017

SOP Title: Perchloric Acid

Supervisor/Principal Investigator/Instructor: Laboratory Safety Manager (Freedman)/Department Head (Bevsek)

Department/Bldg/Room#: Chemistry/Byrd Hall/Room 308

Supervisor/Principal Investigator/Instructor Phone Number: 953-1067(Lab Safety Manager)/953-7790

Section 1 – Process/Experiment

NA

Section 2 – Hazardous Chemicals

Perchloric acid (see attached SDS) is a colorless liquid often used as strong Brønsted-Lowry acid, being comparable in strength to sulfuric acid. It is a **powerful oxidizer**, but its aqueous solutions up to 72% are remarkably inert, only showing strong acid properties and no other oxidizing properties at room temperature. Upon heating, aqueous solutions below 72% do become very strongly oxidizing and can react violently or explode if not handled carefully.
At concentration above 85% (anhydrous), perchloric acid is very unstable and can explode upon contact with organic material.
Many heavy metal perchlorates and organic perchlorate salts are extremely sensitive explosives.
Mixtures of perchlorates with many oxidizable substances are explosive.
Perchloric acid fumes can accumulate on ductwork and equipment. This residue is unstable and extremely dangerous. Great care must be taken to ensure that all perchloric acid fumes are trapped and not allowed to escape into fume hood ductwork .

Section 3 – Potential Hazards

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Oxidizing liquids (Category 1), H271
Corrosive to metals (Category 1), H290
Acute toxicity, Oral (Category 4), H302
Skin corrosion (Category 1A), H314
Serious eye damage (Category 1), H318
Specific target organ toxicity - repeated exposure (Category 2), Thyroid, H373

Signal word: Danger
Hazard statement(s)
H271 May cause fire or explosion; strong oxidizer.
H290 May be corrosive to metals.
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H318 Causes serious eye damage.
H373 May cause damage to organs (Thyroid) through prolonged or repeated exposure.

See attached SDS

Section 4 – Approvals Required

- PI or designee must provide training to the laboratory personnel specific to the hazards involved in working with hazardous chemicals, work area decontamination, and emergency procedures.
- The laboratory personnel should attend the trainings, review this SOP and SDS and complete the documentation of training.
- The trainings should be provided prior to work with hazardous chemicals and annual refresher thereafter.
- PI or designee should inform EHS and the Laboratory Safety Manger for using perchloric acid above room temperature. The Laboratory Safety Manager and EHS will evaluate the operating procedures and advise on the handling requirements.

Section 5 – Designated Area

If there is any risk of perchloric acid fumes escaping the experimental apparatus, then a specially designed and dedicated perchloric acid fume hood must be used that is designed to "wash down" the hood and ductwork. This hood should be labeled for perchloric acid use (see following signage). **This hood is located in Byrd 308.**

Section 6 – Special Handling Procedures and Storage Requirements

Perchloric acid can be only used in areas properly equipped with a certified eye wash/safety shower that can be reached within ten seconds. It is essential that all strong corrosives be stored separately from other laboratory chemicals with which they may react. For oxidizing acids such as perchloric acid this includes all organic material. Ensure secondary containment and segregation of incompatible chemicals. Also, follow any substance-specific storage guidance provided in Safety Data Sheet (SDS) documentation.

The corrosive properties of perchloric acid and its ability to produce fires or explosions by combination with combustible materials make the following considerations mandatory in the selection of a storage site:

- A relatively cool, dry environment free from extremes of temperature--humidity should be maintained.
- Store in a material that is acid-resistant; this facilitates flushing and other cleanup procedures in the event of leaks or spills.
- Store on low shelves or in acid/base storage cabinets.
- **Segregate perchloric acid from organic acids, and flammable and combustible liquids. This is crucial to avoid fires/explosions!**
- Segregate all acids from active metals such as sodium, potassium, magnesium, etc.
- Use bottle carriers for transporting materials when possible.
- When mixing acids and water, always add acid to water. To prevent surface boiling/spattering, **NEVER add water to acid!**
- Store mineral acids together, separate from oxidizing agents and organic materials.
- Store acetic acid and other organic acids with the combustible organic liquids.

Section 7 – Personal Protective Equipment

See the PPE information under Section II of *The Citadel Chemistry Department Chemical Hygiene Plan* regarding:

- what PPE is needed and when/where to use
- recommendations of required PPE found in the SDS
- obtaining your PPE
- glove selection criteria
- respirator use, etc.

At minimum, complete protection of the eyes and skin is essential.

Section 8 – Engineering/Ventilation Controls

For further information, see the following pages in Section II of The *Citadel Chemistry Department Chemical Hygiene Plan*:

- Fume Hood Usage SOP
- Criteria for Implementing Engineering Controls

If quantities, temperature or concentrations of use create a potential explosion hazard, then installation of blast shields around the experimental apparatus is strongly encouraged.

If there is any risk of perchloric acid fumes escaping the experimental apparatus, then a specially designed and dedicated perchloric acid fume hood must be used that is designed to "wash down" the hood and ductwork. This hood is located in Byrd 308.

Section 9 – Spill and Accident Procedures/Decontamination

See directions under the "Chemical Spill Clean-Up Procedures" and "Emergency Response" sections of the CHP. Incident Report forms should already be present in all laboratories.

Student first aid cases are treated at The Citadel's Mary Bennett Murray Infirmary or a local emergency room. Employee and visitor first aid cases are treated through *CompEndium,* and *Concentra*, Dorchester Road (843-554-6737), *Concentra,* Rivers Avenue (843-735-5020) or local emergency room at the direction the Office of Human Resources (843-953-6922 or 953-5376--Benefits Manager).

DECONTAMINATION

Using proper personal protective equipment as outlined above, decontaminate equipment and bench tops using soap and water and properly dispose of all chemical and contaminated disposables as hazardous waste following the guidelines below

Section 10 – Waste Collection/Disposal

See "Chemical Waste Disposal" in Section II of *The* Citadel *Chemistry Department Chemical Hygiene Plan.*
It is crucial to avoid mixing perchloric acid waste with organic waste of any kind. Perchloric acid waste containers should be clearly marked as such to avoid accidental addition of any reducible materials. Failure to do this will cause a violent explosion.

Section 11 – Process Steps

NA

Section 12 – Training

- PI or designee must provide training to the laboratory personnel specific to the hazards involved in working with hazardous chemicals, work area decontamination, and emergency procedures.
- The laboratory personnel should attend the trainings, review this SOP and SDS and complete the documentation of training.
- The trainings should be provided prior to work with hazardous chemicals and annual refresher thereafter.
- Laboratory Safety Manager will keep training records

SOP Prepared by (Name and Title): Tiffany CR Freedman, Laboratory Safety Manager

SAFETY DATA SHEET

Version 3.12 Revision Date 05/24/2016 Print Date 11/29/2017

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Perchloric acid

Product Number : 311421
Brand : Aldrich

CAS-No. : 7601-90-3

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103 USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Oxidizing liquids (Category 1), H271 Corrosive to metals (Category 1), H290 Acute toxicity, Oral (Category 4), H302 Skin corrosion (Category 1A), H314 Serious eye damage (Category 1), H318 Specific target organ toxicity - repeated exposure (Category 2), Thyroid, H373 For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H271 May cause fire or explosion; strong oxidizer.
H290 May be corrosive to metals.
H302 Harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H318 Causes serious eye damage.
H373 May cause damage to organs (Thyroid) through prolonged or repeated exposure.

Precautionary statement(s)

P210	Keep away from heat.
P220	Keep/Store away from clothing/ combustible materials.
P221	Take any precaution to avoid mixing with combustibles.
P234	Keep only in original container.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P283	Wear fire/ flame resistant/ retardant clothing.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/doctor.
P306 + P360	IF ON CLOTHING: rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
P314	Get medical advice/ attention if you feel unwell.
P363	Wash contaminated clothing before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P371 + P380 + P375	In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.
P390	Absorb spillage to prevent material damage.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Synonyms : PCA

Formula : $HClO_4$

Molecular weight : 100.46 g/mol

Hazardous components

Component		Classification	Concentration
Perchloric acid			
CAS-No. EC-No. Index-No.	7601-90-3 231-512-4 017-006-00-4	Ox. Liq. 1; Met. Corr. 1; Acute Tox. 4; Skin Corr. 1A; Eye Dam. 1; STOT RE 2; H271, H290, H302, H314, H318, H373	>= 70 - < 90 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Move out of dangerous area.Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.Continue rinsing eyes during transport to hospital.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable extinguishing media
High volume water jet

5.2 Special hazards arising from the substance or mixture
Container explosion may occur under fire conditions.

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. Keep away from sources of ignition - No smoking.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Storage class (TRGS 510): Strongly oxidizing hazardous materials

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm Break through time: > 480 min
Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: Nature latex/chloroprene Minimum layer thickness: 0.6 mm Break through time: 420 min
Material tested:Lapren® (KCL 706 / Aldrich Z677558, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi- purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid, clear Colour: colourless
b)	Odour	No data available
c)	Odour Threshold	No data available

d)	pH	No data available
e)	Melting point/freezing point	-18 °C (0 °F)
f)	Initial boiling point and boiling range	ca.203 °C (397 °F) at 1,013 hPa (760 mmHg)
g)	Flash point	113 °C (235 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	9.1 hPa (6.8 mmHg) at 25 °C (77 °F)
l)	Vapour density	No data available
m)	Relative density	1.664 g/cm3 at 25 °C (77 °F)
n)	Water solubility	completely miscible
o)	Partition coefficient: n-octanol/water	No data available No
p)	Auto-ignition temperature	data available No
q)	Decomposition temperature	data available
r)	Viscosity	No data available
s)	Explosive properties	Not explosive
t)	Oxidizing properties	The substance or mixture is classified as oxidizing with the category 1.

9.2 Other safety information

No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

Amines and alcohols cause exothermic reactions.

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

Strong bases, Strong acids, Amines, Phosphorus halides, Alcohols, Organic materials, Powdered metals, Strong reducing agents

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Chlorine
Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas Other decomposition products - No data available
In the event of fire: see section 5

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - < 2,000 mg/kg
(OECD Test Guideline 423) Inhalation:

No data available Dermal: No data

available

Skin corrosion/irritation
Extremely corrosive and destructive to tissue.

Serious eye damage/eye irritation
Corrosive

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
Ames test
Salmonella typhimurium Result:
negative

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available No data
available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
May cause damage to organs through prolonged or repeated exposure. - Thyroid

Aspiration hazard
No data available

Additional Information
RTECS: Not available

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to daphnia and other aquatic invertebrates	Immobilization EC50 - Daphnia magna (Water flea) - > 100 mg/l - 48 h (OECD Test Guideline 202)

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
Do not empty into drains. Neutralisation will not reduce ecotoxic effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1873 Class: 5.1 (8) Packing group: I
Proper shipping name: Perchloric acid
Reportable Quantity (RQ): Poison

Inhalation Hazard: No

IMDG

UN number: 1873 Class: 5.1 (8) Packing group: I EMS-No: F-G, S-Q
Proper shipping name: PERCHLORIC ACID

IATA

UN number: 1873 Class: 5.1 (8) Packing group: I
Proper shipping name: Perchloric acid
IATA Passenger: Not permitted for transport

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Reactivity Hazard, Acute Health Hazard

Massachusetts Right To Know Components

Perchloric acid	CAS-No. 7601-90-3	Revision Date 1993-04-24

Pennsylvania Right To Know Components

Perchloric acid	CAS-No. 7601-90-3	Revision Date 1993-04-24
Water	7732-18-5	

New Jersey Right To Know Components

Perchloric acid	CAS-No. 7601-90-3	Revision Date 1993-04-24
Water	7732-18-5	

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Eye Dam.	Serious eye damage
H271	May cause fire or explosion; strong oxidizer.
H290	May be corrosive to metals.
H302	Harmful if swallowed.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
H373	May cause damage to organs (/$/*_ORGAN_REPEAT/$/) through prolonged or repeated exposure.
Met. Corr.	Corrosive to metals
Ox. Liq.	Oxidizing liquids
Skin Corr.	Skin corrosion
STOT RE	Specific target organ toxicity - repeated exposure

HMIS Rating

Health hazard:	3
Chronic Health Hazard:	
Flammability:	1
Physical Hazard	3

NFPA Rating

Health hazard:	3
Fire Hazard:	1
Reactivity Hazard:	3
Special hazard.I:	OX

Further information

Preparation Information
Sigma-Aldrich Corporation Product Safety – Americas Region 1-800-521-8956

Version: 3.12 Revision Date: 05/24/2016 Print Date: 11/29/2017

WARNING!

PERCHLORIC ACID HOOD

NO work with ORGANIC materials is to be done in this hood

EMERGENCY CONTACTS:

BLAKELY ADAIR	953-7791
HOLLY BEVSEK	953-9221
TIFFANY FREEDMAN	953-1067
EHS	953-4816