

Principal Investigator: _____

Date Approved: _____

This document covers basic chemical safety protocols (CSP) for peroxide-forming chemicals (PFCs) and supplements the laboratory Chemical Hygiene Plan as appropriate. Additional lab-specific safety operating procedures for PFCs may also be required. The use of any PFCs is subject to pre-approval by the Principal Investigator (PI) and/or the designated Laboratory Responsible Safety Person. DO NOT USE ANY PFCs UNTIL YOU HAVE OBTAINED THE NECESSARY PRE-APPROVAL AND TRAINING.

Peroxide-Forming Chemicals (PFCs)

Peroxide-forming chemicals (PFCs) are flammable organic liquids which are capable of forming potentially explosive R-O-O-R' peroxide bonds (where R = organic group) upon exposure to air or oxidizing impurities. Peroxides formed in a chemical container are particularly likely to accumulate within the threads of the screw cap, and may explode when subjected to heat, light, friction or mechanical shock (e.g. unscrewing the cap). It is particularly dangerous to allow these materials to evaporate to dryness, such as during distillation, leaving the crystals of peroxide on the surfaces of the container.



Personal Protective Equipment



Lab Coat

Flame resistant lab coat



Gloves

Nitrile or chloroprene gloves typically provide adequate protection against minor splashes. Consult with your PI or supervisor to determine whether any materials involved in your process require alternative hand protection.



Eye Protection

ANSI Z87.1-compliant safety glasses or safety goggles if a splash hazard is present

Labeling & Storage

PFCs should be stored in a flammable storage cabinet with self-closing hinges or in a refrigerator rated for flammable storage. Containers greater than 1 gallon (4L) in size are not recommended but must be stored in a flammable storage cabinet if present. All PFCs must be stored away from combustible materials and oxidizers. PFCs must be marked with receiving date and opening date and be disposed of within the recommended time frame based on the chemical's ability to form peroxides

<p>Class A PFCs form explosive levels of peroxides without concentration. Store under inert gas if possible. Submit as waste or evaluate for peroxides within 3 months of opening.</p>	<ul style="list-style-type: none"> • Butadiene (inhibited liquid monomer) • Chlorobutadiene • Diisopropyl Ether • Divinylacetylene 	<ul style="list-style-type: none"> • Potassium amide • Potassium metal • Sodium amide • Tetrafluoroethylene • Vinylidene Chloride
<p>Class B PFCs readily form explosive peroxides when they become concentrated (e.g., via evaporation or distillation). Stabilizers like hydroquinone and BHT inhibit peroxide formation. However, the concentration process defeats the action of most stabilizers. Store</p>	<ul style="list-style-type: none"> • Acetaldehyde • Cumene • Cyclohexene • Cyclopentene • Diacetylene • Dioxanes 	<ul style="list-style-type: none"> • Furan • Propyne • Methylcyclopentane • Vinyl ethers • Tetrahydrofuran • 2-Propanol

under inert gas if possible. Submit as waste or evaluate for peroxides within 6 - 12 months of opening	<ul style="list-style-type: none"> • Diethyl Ether • Diacetylene 	<ul style="list-style-type: none"> • Other secondary alcohols
<p>Class C PFCs can auto polymerize upon peroxide concentration. These may explode when relatively small quantities of peroxides are formed. These items normally have an inhibitor added by the manufacturer to prevent peroxides from forming. This inhibitor can be removed if it interferes with the use of the chemical or the chemical is redistilled in the lab. If a procedure requires the use of an uninhibited item in this Class, please contact EHSS.</p> <p>Without inhibitor: Submit as waste within 24 hours after synthesizing or opening.</p> <p>With inhibitor: Do not store under inert atmosphere (O₂ is required for inhibitors to work). Submit as waste or evaluate for peroxides within 12 months of opening</p>	<ul style="list-style-type: none"> • Acrylic acid • Acrylonitrile • Butadiene • Chlorotrifluoroethylene • Ethyl acrylate • Methyl methacrylate • Styrene 	<ul style="list-style-type: none"> • Tetrafluoroethylene • Vinylacetylene • Vinyl Acetate • Vinyl Acetylene • Vinyl Chloride • 2-Vinylpyridine • Vinyladiene chloride
<p>Class D: May Form Peroxides These chemicals have the potential to form peroxides with varying conditions of use but are normally stable. Consult the manufacturer's SDS to determine when peroxide formation is expected and label accordingly</p>	<ul style="list-style-type: none"> • Acrolein • Allyl ether • 2-Bromomethyl ethyl ether • Diallyl ether • Diethoxymethane 	<ul style="list-style-type: none"> • Ethyl vinyl ether • Isoamyl ether • 2-Methoxyethanol • a-Phenoxypropionyl chloride • (+)-Valinomycin

Engineering Controls, Equipment & Materials

Fume Hood If your protocol requires handling PFCs outside of a fume hood, contact the Office of Environment, Health, Safety, and Sustainability (EHSS) to determine whether alternative engineering controls or additional respiratory protection is warranted.

Cautions & Considerations

Static Electricity

Large containers of PFCs are discouraged given the strict limits on prolonged storage. If required due to high demand, all large containers should always be grounded, and should be bonded to the receiving container during transfer. Always transfer flammable chemicals from glass containers to glassware or from glass container/glassware to plastic. Transferring these types of chemicals between plastic containers or unbonded metal containers may lead to a fire hazard due to static electricity.

Housekeeping

Spills

Notify others in the area of the spill, including your PI/Responsible Safety Person. If it is a small spill that you can easily handle, use the contents of your lab spill kit to clean it up. If it is a large spill, then evacuate the area where the spill occurred. Call Vanderbilt University Public Safety (VUPS) at 615-421-1911 or use the Vandysafe app on your smart phone. Report any exposure through Risk and Insurance Management's Origami portal and mark that it occurred in research when prompted. Both VUPS and the Origami system will notify EHS of the incident. Remain on-site at a safe distance to provide detailed information to first responders.

Decontamination Decontamination methods will vary based on the materials handled and equipment being used. Please review the chemical Safety Data Sheet for guidance on cleaning materials.

Waste Note: Empty containers of PFC's can still pose a hazard and may quickly evaporate to dryness. Containers should be triple-rinsed, and the rinsate collected for disposal as hazardous waste. Refer to the laboratory *Chemical Hygiene Plan* (Section 6.7) for information on proper chemical waste disposal procedures.

First Aid & Emergencies

Skin or Eye Contact Remove contaminated clothing and accessories; flush affected area with water. If symptoms persist, get medical attention.

Inhalation Move person into fresh air. If symptoms persist, get medical attention.

Ingestion Rinse mouth with water. If symptoms persist, get medical attention.

*Sources: Prudent Practices in the Laboratory, NAP 2011; Kelly, ACS 1996; Kelly, LLNL 1999; Mason, JCHS 2014; Clark, JCHS 2001; Jackson, JChemEd 1970; Stanford EHS Info Sheet on Peroxides

