

# Standard Operating Procedure Peroxide Forming Chemicals

Print a copy of this SOP and insert into your Safety Binder.

## - SOP Information

Department:	CSUDH – (Name of your Department)	
Date SOP was written:	Click or tap to enter a date.	
Date SOP was approved by PI/Iab supervisor:	Click or tap to enter a date.	
Principal Investigator:	Click or tap here to enter text.	
Chemical Hygiene Officer /Lab Manager:	Ricardo Magallanes/	
Lab Phone:	(XXX) – XXX – XXXX	
Office Phone:	(XXX) – XXX – XXXX	
Emergency Contact:	EHS (310) 243 – 3000	
	(Name and Phone Number)	
Location(s) covered by	Campus	
this SOP:	(Building/Room Number)	
LI		

SOP Type: [D] Specific lab procedure or experiment

[⊠] Generic use of specific chemical or class of chemicals w/ similar hazards [D] Generic use of highrisk equipment

### Contents

-	SOP Information	. i
1.	Purpose	1
2.	Subject Chemicals Used in this Laboratory	1
3.	Properties & Hazards	1
4.	Administrative Control	2
5.	Engineering Control	2
6.	Personal Protective Equipment	3
7.	Special Handling & Storage Requirements	4
8.	First Aid	5
9.	Medical Emergency	6
10.	Spill & Accident Procedures	6
11.	Decontamination & Waste Disposal Procedure	7
12.	Safety Data Sheet (SDS) Location	7
13.	Required Travel/Approvals	7
14.	Additional Notes	8
15.	Documentation of Training	8
16.	Lab Specific Procedures1	0

#### Definitions

**P.I.** – Principal Investigator. Usually a professor in charge of a laboratory or set of laboratories who is actively undertaking research. They are considered the front-line supervisor and are responsible for training and personnel safety in the laboratory.

**SDS** – Safety Data Sheets. An essential component of the GHS and are intended to provide comprehensive information about a substance or mixture for use in workplace chemical management. Also Known as MSDS (Material Safety Data Sheet)

**S.O.P.** – Standard Operating Procedure. A written set of instructions that document how to safely perform work involving hazardous chemicals or hazardous operations. Includes training documentation.

### 1. Purpose

The purpose of this standard operating procedure is to acquaint you with the proper and safe handling, use, storage and disposal of the subject chemicals.

### 2. Subject Chemicals Used in this Laboratory

Refer to the banded laboratory chemical inventory located in the chemical inventory program for a listing of all chemicals in this laboratory that this SOP applies to. In addition, the banded inventory includes chemical-specific notations that supplements the information provided in this SOP (e.g., special hazards, handling, PPE).

### 3. Properties & Hazards

Chemicals in this band can form peroxides over time and can become sensitive to heat, shock, or friction. Their accumulation in laboratory reagents has resulted in numerous explosions. Peroxide formation in common laboratory chemicals is caused by an autoxidation reaction. The reaction can be initiated by light, heat, introduction of a contaminant, or the loss of an inhibitor (some chemicals have inhibitors to slow peroxide formation). All peroxide forming chemicals are considered highly hazardous.

There are not specific hazard classifications for peroxide forming chemicals defined by Cal/OSHA or GHS. Depending on the danger of peroxide accumulation, peroxide-forming chemicals can be divided into three categories (Class A-C).

**Class A**: Chemicals that form explosive levels of peroxides without concentration. These are the most hazardous and can form explosive peroxide levels even if not opened. **Test for peroxide formation or discard after 3 months of receiving the chemicals**. Examples of Class A peroxide formers include:

Isopropyl ether Potassium amide Divinyl acetylene Sodium amide Potassium metal Vinvlidene chloride

**Class B**: Chemicals that form explosive levels of peroxides on concentration through distillation, evaporation or exposure to air after opening. **Test for peroxide formation or discard after 12 months.** Examples of Class B peroxide formers include:

Acetal	Acetaldehyde	Benzyl Alcohol
2-Butanol	Chlorofluoroethylene	Cumene(isopropylbenzene)
Cyclohexene	2-Cyclohexen-1-ol	Cyclopentene
Decahydronapthalene(decalin)	Diacetylene(butadiyne)	Dicyclopentadiene
Diglyme	Diethyl ether	2-Hexanol
Furan	4-Heptanol	Methyl-isobutyl ketone
Methyl Acetylene	3-Methyl-1-butanol	4-Penten-1-ol
4-Methyl-2-pentanol	2-Pentanol	Tetrahydronapthalene
1-Phenylethanol	Tetrahydrofuran	1,4-Dioxane
Vinyl Ethers	Sec. Alcohols	Ethylene glycol ether acetates
Ethylene glycol dimethyl ether (g	lyme)	

**Class C**: Chemicals that may autopolymerize as result of peroxide formation. **Test for peroxide formation or discard after 12 months.** Examples of Class C peroxide formers include:

Acrylic acid Tetrafluoroethylene Chloroprene Vinyl chloride Styrene Butadiene Vinyl acetate Methyl methacrylate Acrylonitrile Vinyl acetylene Chlorotrifluoroethylene Vinyl pyridine

### 4. Administrative Control

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

#### **General practices:**

- 1. Be sure to review the Safety Data Sheet (SDS) for all chemicals to be used in the experiment.
- 2. <u>Never</u> work alone. At least one other person must be present in the same laboratory when any work involving hazardous chemicals is being done.
- 3. Eliminate or substitute for a less hazardous material when possible.
- 4. Design your experiment to use the least amount of material possible to achieve the desired result.
- 5. Verify your experimental set-up and procedure prior to use. Be familiar with the Safety Data Sheets for all chemicals in use. Assess the hazards to ensure that appropriate controls are in place to minimize risk and address emergency shut-down procedures as appropriate.
- 6. Consult with the PI if the work involves procedure scale-up or other large quantities or there are any questions regarding appropriate safety procedures.

### 5. Engineering Control

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

#### Band-specific practices:

- 1. Keep the material under inert atmosphere (e.g., nitrogen, argon) when not in use, except for those chemicals that contain an inhibitor that requires oxygen to function (styrene, a List C compound).
- 2. Work in a properly functioning chemical fume hood when handling potentially explosive compounds. Work with the sash as low as possible.
- 3. A portable blast shield, inside the hood, is recommended when working with potentially explosive compounds.

### 6. Personal Protective Equipment

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

#### **Respiratory Protection**

Respiratory protection is generally not required for lab research, provided the appropriate engineering controls are employed. Respirators should be used only under any of the following circumstances:

Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EH&S. This is a regulatory requirement. If you think that your process may require respirator use, contact EH&S for assistance.

#### Hand Protection

Disposable nitrile gloves provide sufficient protection for most routine lab operations involving small quantities. They should be changed if liquid is splashed onto them. They are not appropriate for longer operations or operations using larger quantities.

For longer operations, or operations using larger quantities, use thicker gloves made from a material appropriate for the specific chemical in use (e.g., natural rubber, butyl, neoprene, nitrile, PVA). When working chemicals or processes that increase the risk of exposure to fire, use hand protection appropriate to both the risk of chemical exposure and the risk from fire. Gloves must be inspected prior to use for signs of wear or damage. Such gloves should be disposed of in accordance with appropriate laboratory disposal practices.

Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with any chemical residues on the surface. Wash and dry hands after use.

For additional information on selection of glove material, review the specific chemical Safety Data Sheet. Consult with your preferred glove manufacturer's website to ensure that the gloves you plan on using are compatible with a specific chemical substance. Common manufacturer glove selection guidance can be found at:

http://www.ansellpro.com/download/Ansell\_8thEditionChemicalResistanceGuide.pdf http://www.allsafetyproducts.biz/page/74172 http://www.showabestglove.com/site/default.aspx http://www.mapa-pro.com/our-gloves/protections/chemical-protection/b/handled\_product.html

#### **Eye Protection**

Use safety glasses with side shields or tightly fitting safety goggles whenever working in the laboratory.

#### **Skin and Body Protection**

Long pants, closed toed-shoes, shirt and a lab coat must be worn whenever working in the laboratory. Flame resistant Nomex® lab coats should be used when working with chemicals or processes that increase the risk of fire. Fully extend sleeves to the wrists and keep buttoned at all times. Avoid wearing synthetic clothing when practicable.

#### **Hygiene Measures**

Wash hands immediately and thoroughly after handling chemicals. Any contaminated clothing should be disposed of or washed before reuse.

### 7. Special Handling & Storage Requirements

In addition to the practices described below, follow procedures as specified in the lab-specific section of this SOP.

Band-specific practices:

- 1. Minimize the quantity of peroxide forming chemicals in the lab.
- 2. Label each container with the Date Received, Date Opened and Date Last Tested.
- 3. Segregate these compounds from incompatible materials. Store away from ignition sources.
- 4. Protect from flames, static electricity, and sources of heat.
- 5. Test for peroxides before any distillation or purification of peroxide forming chemicals.
- 6. NEVER distill peroxide-forming chemicals to dryness. Always leave a minimum of 20% still bottoms. When possible, add a non-volatile organic compound (such as mineral oil) to dilute any peroxides remaining after distillation.
- 7. Use extreme caution before concentrating or purifying peroxide forming chemicals as most explosions occur during these processes.
- 8. Wear proper personal protective equipment when working with peroxide forming chemicals.
- 9. Minimize peroxide formation in ethers by storing in tightly sealed containers in a cool place in the absence of light. Consider blanketing the head space of the container with an inert gas prior to returning the container to storage.
- 10. Additional information regarding the safe handling and use of oxidizers can be found at:
  - a. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (section 6.G. Working with Highly Reactive or Explosive Chemicals -<u>http://www.nap.edu/openbook.php?record\_id=4911&page=51</u>
- 11. Peroxide forming chemicals should be stored in their original manufacturer's container whenever possible. This is very important in the case of diethyl ether because the iron in the steel shipping containers acts as a peroxide inhibitor. In general, peroxide-forming chemicals should be stored in sealed, air-impermeable containers and should be kept away from light (light can initiate peroxide formation). Dark amber glass with a tight fitting cap is appropriate
- 12. Visual Inspection- Visually inspect all peroxide-forming chemicals before any operation.
- 13. For liquids: Evidence of possible peroxide formation in liquids includes:
  - a. Solids or crystals are observed in either the liquid
  - b. Solids or crystals are observed around the cap of peroxide forming chemicals
  - c. Visible discoloration
  - d. Liquid stratification
  - e. Do not open or move the container but contact EH&S for disposal.
  - f. Diethyl ether is commonly sold in steel containers which prevents visual inspection of the liquid. Therefore, diethyl ether containers whose age and use history are unknown should be assumed to contain dangerous levels of peroxides and should not be disturbed.

- 14. For solids: Evidence of possible peroxide formation in solids (potassium metal, potassium amide, and sodium amide) includes:
  - a. Formation of a surface crust (for example, potassium metal forms a yellow or orange superoxide at the surface)
  - b. Discoloration of the solid
  - c. Evaluation of alkali metals and their amides is based on visual criteria only. These substances react strongly with water, and the standard operating procedures for handling water reactive compounds (WRC) should be followed for these chemicals, as well as the precautions described in this SOP.
  - d. Containers that exhibit any unusual visual characteristics, such as the examples listed below, should be assumed to contain dangerous levels of peroxides and should not be disturbed. Notify EH&S, who will assist in the further evaluation. If there is any doubt about the safety of handling a chemical container, notify EH&S immediately.
  - e. Materials not passing visual inspection are considered to be high risk and will have to be disposed of by special means (limit handling and movement; notify EH&S). Only chemicals that pass visual inspection should be tested.
- 15. Testing for Peroxides
  - a. Researchers should never test containers of unknown age or origin. Older containers are far more likely to have concentrated peroxides or peroxide crystallization in the cap threads and therefore can present a serious hazard when opened for testing.
  - b. Never try to force open a rusted or stuck cap on a container of a peroxide-forming chemical.
  - c. All peroxide forming chemicals which are to be distilled must be tested prior to distillation regardless of age.
  - d. A peroxide-forming chemical should be disposed of by the end of the expiration date, or tested for peroxide content.
  - e. Materials which are older than the suggested shelf life but have been tested and have peroxide concentrations less than 100 PPM may be retained but should be tested at regular intervals,
  - f. Any container found to have a peroxide concentration greater than or equal to 100 PPM should be disposed of (call EHS&S for assistance).
  - g. The most convenient test method is the use of peroxide test strips manufactured by Aldrich and several other suppliers; they may be obtained from EHS&S. Strips that offer a 1-100 PPM peroxide range are useful for determining if the material is below the control point of 100 PPM. Other testing methods are available. Contact EHS&S for more information.

### 8. First Aid

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

Consult the Safety Data Sheet for the subject chemical for specific first aid procedures. General first aid procedures for hazardous chemicals are provided below.

#### If inhaled

Move to fresh air. Have victim rest in half-upright position. Artificial respiration victim is not breathing. Seek medical attention immediately.

#### In case of skin contact

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately

#### In case of eye contact

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water from emergency eyewash station for at least 15 minutes. Get medical attention immediately.

#### If swallowed

If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

### 9. Medical Emergency

Be familiar with information in the CSUDH Emergency poster.

**a. Life Threatening Emergency** (all times: Business Hours, After Hours, Weekends and Holidays)--CALL 911 if the condition is LIFE THREATENING or REQUIRES IMMEDIATE MEDICAL ATTENTION. <u>Note</u>: All serious injuries <u>must</u> be reported to EH&S at **ext. 2895** within 8 hours. Complete online incident report at <u>https://www.csudh.edu/Assets/csudh-sites/rm-ehos/docs/risk-management-ehos/accident-report-form-std-268.pdf</u>

**b.** Non-Life Threatening Emergency – Notify your supervisor or faculty staff if condition is not life threatening or does not require immediate medical attention.

ALL WORK RELATED INJURIES MUST BE REPORTED via the On-line Incident Form <a href="https://www.csudh.edu/hr/workers-compensation/">https://www.csudh.edu/hr/workers-compensation/</a> or call Human Resources, Workers Compensation (310) 243-3771.

### 10. Spill & Accident Procedures

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

Evacuate the spill area. Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering the area. Keep the appropriate fire extinguisher nearby. Avoid incompatible extinguishing agents. Use Class A-B-C or B-C for flammable liquids. **Fire extinguishers containing water are not suitable for flammable liquid fires.** 

**Spill** – Assess the extent of danger. Help contaminated or injured persons if safe to do so. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

**Small (<1 L, <100 g)** – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large (>1 L, >100 g) – Dial 911 and EH&S at ext. 3000 for assistance.

**Chemical Spill on Body or Clothes** – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. *Notify supervisor and EH&S at* **ext. 3000** *immediately.* 

**Chemical Splash Into Eyes** – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EH&S at* **ext. 3000** *immediately.* 

### 11. Decontamination & Waste Disposal Procedure

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

All of the subject chemicals must be disposed as a hazardous waste.

#### Label Waste

 Hazardous waste labels must be placed on the hazardous waste container upon the start of accumulation.

#### **Store Waste**

- Hazardous waste containers must be kept closed, except when adding waste.
- Hazardous waste containers must be stored in secondary containment to adequately contain all of the contents of the container.
- Hazardous waste containers must be inspected weekly for signs of leaks, corrosion, or deterioration.

#### **Dispose of Waste**

- Hazardous waste must be transferred to EH&S for disposal within 6 months of being generated.
- Empty Containers: At no time should full or partially full containers be placed in the trash.
- Hazardous Waste Disposal:
  - Visit: <u>https://www.csudh.edu/ehs/environmental/hazardous-waste</u>
  - o Fill out the "CSUDH Hazardous Waste Label"
  - EH&S will pick up your waste within 1-3 days.
  - Do not dispose of chemicals by pouring them down the drain or placing them in the trash.
- Do not use fume hoods to evaporate chemicals.

### 12. Safety Data Sheet (SDS) Location

Online SDSs can be accessed at http://hq.msdsonline.com/csuedusl

### 13. Required Travel/Approvals

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

All work with the subject chemicals requires the following prior to beginning work:

- 1. Must be pre-approved by the Principal Investigator prior to use and all training must be well documented.
- 2. Must be familiar with the CSUDH Chemical Hygiene Plan. https://www.csudh.edu/ehs/health-safety-programs-policies/
- 3. Must have documented Laboratory Safety training.
- 4. Must read the relevant Safety Data Sheet (formerly referenced as Material Safety Data Sheets).
- 5. Any additional laboratory specific training that is needed is referenced in the 'Laboratory Specific Use Procedures' section. Signed and dated training documents must be uploaded into each assigned researchers training records.

#### Band-specific practices:

1. Any work with Class A peroxide-forming chemicals must be pre-approved by the Principal Investigator prior to use.

### 14. Additional Notes

Any deviation from this SOP requires approval from P.I.

### 15. Documentation of Training

- Prior to conducting any work with the subject chemicals, designated personnel must provide training to his/her laboratory personnel specific to the hazards and procedures involved in working with these substances.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year.

#### I have read and understand the content of this SOP:

Name	Signature	CSUDH ID #	Date


### 16. Lab Specific Procedures

The following describe how the subject chemicals are used in this laboratory beyond the practices described above.

This section must describe lab-specific procedures to address the safe use of all highly hazardous chemicals from this band in use in the laboratory. These procedures may be organized around specific chemicals, specific tasks or the band as a whole. The following minimum requirements must be met:

- Identify designated use areas within the laboratory for highly hazardous chemicals in the following hazard bands:
  - o Carcinogens
  - Reproductive Toxins
  - Toxic Chemicals
- Identify maximum use quantities for which the procedures in this band apply.
- If it is determined that this hazard band SOP is sufficient to address the safe use of all subject chemicals in this lab, then include the following statement in this section: *"Procedures described in this hazard band SOP are sufficient for addressing the safe use of subject chemicals in this laboratory within the listed quantity limitations."*
- If it is determined that this hazard band SOP is not sufficient to address the safe use of all chemicals from that band in the lab, then write lab-specific procedures for to address these high hazard operations. Such operations are generally indicated by:
  - o tasks requiring the use of specialized PPE,
  - o tasks using highly hazardous chemicals outside of the fume hood,
  - o tasks using larger quantities of hazardous chemicals,
  - tasks involving the use of particular chemicals considered by CSUDH EHS to be extremely hazardous, and
  - o tasks considered to present high risk by lab personnel.

#### A few examples of what lab-specific tasks may look like are provided below:

#### Task #1: Title of the specific procedure being done.

- 1) Provide step-by-step instructions in a numbered/lettered format.
- 2) Include in the procedure any relevant:
  - a) Locations of "designated areas" as called for in the special handling section of the SOP, or as otherwise required by regulations. The entire laboratory, fume hood, or a portion of the laboratory may be considered as a designated area.
  - b) Use of specific administrative, engineering and PPE controls.
  - c) Specific quantity use limits/restrictions.
  - d) Specific storage requirements.
  - e) Specific first aid and spill procedures (including what should be handled by whom).
  - f) Specific disposal procedures.
  - g) Process-specific PI approvals required.

#### Task #2: Making dilutions of the acids and bases.

- 1) Consult with PI and obtain approval if quantities greater than 4 L are needed.
- In a fume hood, add the appropriate amount of concentrated acid or base to the calculated amount of water.
- 3) Return the concentrated acids/bases to the proper secondary containment or cabinet.

#### Task #3: Using the pH meter.

- 1) Calibrate on the day of pH testing using at least 2 standards.
- 2) Before use, rinse the electrode with deionized water and blot dry with a kim-wipe.
- Transfer the electrode to the test solution.
   If using a stir plate, make sure the electrode does not touch the stir bar.
- 5) Record the pH when the reading is stable (5-20 seconds after insertion of the electrode into the solution)
- 6) Add dilute acid or dilute base drop-wise until the correct pH is reached.
- 7) Rinse the electrode with deionized water and store according to the manufacturer's instructions.
- 8) Make sure the acid and base caps are on tightly.

Add as many tasks as necessary.

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
1. Peroxide Forming Chemicals (PFCs) are used in the lab as a solvent	Up to 2 L PFC per reaction or extraction	All work using PFCs must be performed in a ventilated fume hood.	<b>Eye protection</b> : Wear ANSI approved tight- fitting safety goggles or safety glasses with side shields.	Do not allow to evaporate to near dryness unless absence of peroxides has been shown.
extractions and		Eliminate ignition sources such as open flames, hot surfaces, steam baths, static electricity, and operation of mechanical	Face protection: Wear a face shield when handling containers of PFC that are not behind a lab hood sash or blast shield.	If a PFC is concentrated on the rotary evaporator use two dry ice traps to collect the solvent vapors.
		and electrical equipment that is not safe. Ensure proper grounding and avoid creating static electricity.	<b>Gloves:</b> PFCs penetrate most common lab gloves rapidly. Extended contact with diethyl ether is not allowed. To protect against incidental contact, wear Laminate Film gloves (e.g. Ansell Barrier) or double nitrile or butyl	Distillation/evaporation of PFCs efficiently removes all stabilizers. Collected fractions (rotavap) must be treated as unstabilized PFC and must be disposed of soon after generation.
		Be sure to ground metal containers when transferring flammable liquids. Use a blast shield if a PFC may	gloves (8 mil). Change outer glove as soon as contaminated. <b>Note</b> : diethyl ether penetrates 4 mil gloves in 2 minutes. <b>Clothing</b> : Wear fire/flame resistant lab coat	Pressure can be built up if a PFC is used in reactions. Adequate ventilation (pressure bubbler on Schlenk manifold, or an equilibrating balloon) has to be used to
		be distilled to dryness or evaporated to dryness.	(100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	prevent dangerous over pressurization. Pressure is built up if a PFC is used in extractions. Adequate ventilation (open the valve frequently during the extraction) has to be used to prevent dangerous over pressurization.
				If heated, the reaction apparatus has to be fitted with an adequately sized condenser and an adequate flow of cooling water has to be provided to prevent evaporation. Cooling hoses have to be secured with metal hose clamps to the condenser and the outlet.

			If distillation or evaporation of a PFC to dryness is possible, a second worker must be present outside the potential explosion zone.
Notes	Any deviation from this SOP requires appr	val from PI.	

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions		
2. Peroxide Forming Chemicals (PFCs) are used in the lab as a solvent in column	Up to 1 <i>liter</i> total eluent volume of	All work using a PFC must be performed in a ventilated fume hood.	Eye protection: Wear ANSI approved tight- fitting safety goggles or safety glasses with side shields.	Eluent may contain no stabilizers. Use a blast shield if eluent may be evaporated to dryness.		
chromatograpy.	PFC	Eliminate ignition sources such as open flames, hot surfaces, steam baths, static electricity, and operation of mechanical	Face protection: Wear a face shield when handling containers of PFCs that are not behind a lab hood sash or blast shield.	Do not allow to evaporate to near dryness unless absence of peroxides has been shown.		
		and electrical equipment that is not intrinsically safe.	Gloves: PFCs penetrate most common lab gloves rapidly. Extended contact with a PFC is not allowed. To protect against incidental contact, wear Laminate Film (Ansell Barrier).	If a PFC is concentrated on the rotary evaporator use two dry ice traps to collect the solvent vapors.		
		avoid creating static electricity. Be sure to ground metal containers when transferring flammable liquids.	Silver Shield (North), butyl rubber or neoprene gloves. Change gloves as soon as contaminated.	Distillation/evaporation of a PFC efficiently removes all stabilizers. Collected fractions (rotavap) must be treated as unstabilized PFC and must be disposed of soon after		
		Use a blast shield if a PFC may be distilled to dryness or evaporated to dryness.	Clothing: Wear fire/flame resistant lab coat (100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	generation.		
Notes	Any deviation	Any deviation from this SOP requires approval from PI.				

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
3. Vinyl acetate can be used as a reagent in a wide range of organic reactions.	Up to 60 mL for each experi- ment.	<ul> <li>Vinyl acetate must be used in a well-ventilated fume hood.</li> <li>Eliminate ignition sources such as open flames, hot surfaces, steam baths, static electricity, and operation of mechanical and electrical equipment that is not safe.</li> <li>Ensure proper grounding and avoid creating static electricity. Be sure to ground metal containers when transferring flammable liquids.</li> <li>Use a blast shield if vinyl acetate may be distilled to dryness or evaporated to dryness.</li> </ul>	<ul> <li>Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.</li> <li>Face protection: Wear a face shield if not protected by a fume hood sash.</li> <li>Gloves: Wear gloves – butyl gloves recommended. 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. Change gloves as soon as contaminated. Wash and dry hands after use.</li> <li>Clothing: Wear fire/flame resistant lab coat (100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.</li> </ul>	Use the smallest amount necessary to complete the experiment. Vinyl acetate must be stored in the original container by the chemical supplier. For small quantities (<10 mL) a syringe should be used to transfer vinyl acetate from its container to the reaction vessel. For intermediate quantities (10-60 mL) either a syringe or graduated cylinder may be used to transfer the reagent. Large quantities (>60 mL) may be transferred using a graduated cylinder. Add vinyl acetate slowly to the reaction vessel already containing solvent. Authorized person using vinyl acetate is responsible for the safe collection and disposal of waste. Never dispose into container with incompatible materials. Never dispose into sink drain.
Notes	Any deviati	on from this SOP requires approval	from PI.	

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
4. Tetrahydrofuran is used in the lab as a solvent to dissolve polymers (PS, PMMA, Ti(iPr)2, etc) for	Up to 50 ml Tetrahydr o-furan per	All work using Tetrahydrofuran must be performed in a ventilated fume hood.	Eye protection: Wear ANSI approved tight- fitting safety goggles or safety glasses with side shields.	Do not allow to evaporate to near dryness unless absence of peroxides has been shown. If THF is concentrated on the rotary evaporator use two dry ice traps to collect the solvent vapors.
coating silicareactionmicrojets or toordissolve hydrophobicextractioncompounds.	reaction or extraction	Use a blast shield if Tetrahydrofuran may be distilled to dryness or evaporated to dryness.	Face protection: Wear a face shield when handling containers of Tetrahydrofuran that are not behind a lab hood sash or blast shield.	Distillation/evaporation of THF efficiently removes all stabilizers. Collected fractions (rotavap) must be treated as unstabilized THF and must be disposed of soon after generation.
			Gloves: Tetrahydrofuran penetrates most common lab gloves rapidly. Extended contact with Tetrahydrofuran is not allowed. To protect against incidental contact, wear Laminate Film (Ansell Barrier), Silver Shield (North), butyl rubber or peoprene gloves. Change gloves as	Pressure can be built up if THF is used in reactions. Adequate ventilation (pressure bubbler on Schlenk manifold or an equilibrating balloon) has to be used to prevent dangerous over pressurization.
		Clothing: Wear fire/flame resistant lab coat	Pressure is built up if THF is used in extractions. Adequate ventilation (open the valve frequently during the extraction) has to be used to prevent dangerous over pressurization.	
			clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	If heated, the reaction apparatus has to be fitted with an adequately sized condenser and an adequate flow of cooling water has to be provided to prevent evaporation. Cooling hoses have to be secured with metal hose clamps to the condenser and the outlet.
				If distillation or evaporation of THF to dryness is possible, a second worker should be present outside the potential explosion zone

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
5. Use of PFCs for crystallization trials.	forUp to 50All work must be performed in a ventilated fume hood.als.ml of a PFCa ventilated fume hood.PFCEliminate materials from the	Eye protection: Wear ANSI approved tight- fitting safety goggles or safety glasses with side shields.	Ensure that no perchlorates are opened in the same area. Open only briefly and cap quickly again.	
wor incc		work area that are incompatible with the PFC.	Face protection: Wear a face shield when handling containers of PFC that are not behind a lab hood sash or blast shield.	Use a secondary container and only draw small volumes (2-3 ml) at a time.
		Gloves: Wear butyl rubber or Viton gloves. Clothing: Wear flame resistant lab coat; cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.		
Notes	Any deviation from this SOP requires approval from PI.			

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Precautions
6. Tetrahydrofuran is	Up to 50	All work using Tetrahydrofuran	Eye protection: Wear ANSI approved tight-	Do not allow to evaporate to near dryness
solvent in the	Tetrahydr	ventilated fume hood.	shields.	shown.
production of thin	o-furan			
PMMA films.	per set of	Use a blast shield if	Face protection: Wear a face shield when handling containers of Tetrahydrofuran that are	If distillation or evaporation of
	films is used	distilled to dryness or evaporated to dryness.	not behind a lab hood sash or blast shield.	second worker should be present outside the potential explosion zone.
			Gloves: Tetrahydrofuran penetrates most common lab gloves rapidly. Extended contact	Small amounts of PMMA are dissolved in
			against incidental contact, wear Laminate Film	solutions are then either spin-coated or
			(Ansell Barrier), Silver Shield (North), butyl	drop cast onto a specific substrate.
			rubber or neoprene gloves. Change gloves as soon as contaminated.	Films are left to dry in a desiccator or inside
				of a fume hood.

			Clothing: Wear fire/flame resistant lab coat (100% cotton based); cotton based clothing/attire; full length pants or equivalent; and close-toed, close-heeled shoes.	
Notes	Any deviation from this SOP requires approval from PI.			