Contents

USC Policy for Managing Peroxide-Forming Chemicals

This document outlines a detailed policy for managing peroxide-forming chemicals at USC research and teaching laboratories, ensuring safety, compliance, and proper handling.

Purpose

Peroxide-forming chemicals, such as ethers (e.g., diethyl ether, tetrahydrofuran), alkenes, aldehydes, and certain solvents, can react with oxygen over time to form unstable organic peroxides. These peroxides are highly reactive, posing significant risks of fire, explosion, or violent reactions when exposed to heat, shock, or friction. This policy aims to minimize these hazards, ensure compliance with regulations like OSHA and EPA, and promote a safe working environment.

Policy Scope and Applicability

This policy applies to all department Administrators, EH&S Staff, and laboratory personnel, including Principal Investigators, Research Staff, Research Lab students and Teaching coordinators who handle, store, dispose, or facilitate the disposal of peroxide-forming chemicals within the university's facilities. It covers teaching and research laboratories, chemical stockrooms, and storerooms.

Definitions and Classifications

- Campus Optics: the online chemical management system used at USC.
- Peroxide-Forming Chemicals (PFCs): Substances prone to forming peroxides, listed in Appendix 1, and others that may not be on this list.
- Peroxide formation is an autoxidation process driven by the reaction of oxygen with specific structural features (e.g., weak C-H bonds near oxygen or double bonds). This may initially occur slowly, but several factors accelerate this process by promoting radical initiation, propagation, or the accumulation of peroxides. These factors include: 1) exposure to air, light and heat, 2) trace metal catalysts like Fe, Cu, Co, 3) concentration by evaporation or distillation, 4) mechanical stress, and 4) impurities like acids, bases, or radical initiators.

- PFC Classes:
    - Class A: Chemicals that form explosive levels of peroxides through autooxidation without concentration. Severe peroxide hazard after prolonged storage, especially after exposure to air.
    - Class B: Form explosive peroxides upon concentration, such as through evaporation, distillation, or other processes that reduce volume.
    - Class C: Form peroxides internally through autoxidation. These peroxides can then initiate auto-polymerization, where the chemical starts to polymerize on its own, potentially leading to dangerous situations like explosions or fires.
    - Class D: May form peroxides under extreme or prolonged conditions (heat, light, air, contaminants, inhibitor depletion), but do not fit clearly into other categories.
- Inhibitor/Stabilizer: A chemical additive (e.g., BHT, hydroquinone) that slows peroxide formation.
- Received date: the date the chemical shipment from the manufacturer was received in your laboratory.
- Opened date: the date the chemical container was first opened.
- Expiration Date: The date (stamped by the manufacturer) beyond which a chemical is deemed unusable and a hazardous waste unless prior testing and stabilization proves otherwise.

Responsibilities

This policy assigns clear roles and responsibilities to the following stakeholders:

- Principal Investigators – Ensure laboratory personnel manage peroxide-forming chemicals according to all provisions outlined in this policy (e.g., procurement, training, labeling, storage conditions, handling, testing and stabilization, disposal, quarterly inventory verifications and records). The PI may delegate responsibility for specific tasks to a qualified research group member (PFC Manager), but the PI is ultimately responsible for the proper management of PFCs in their laboratory.
- PFC Manager – A research group member skilled and trained in safely managing PFCs. This individual must understand all provisions of this policy. PFC Manager(s) must also have training and experience necessary to recognize peroxide formation, oversee procurement, ensure proper storage conditions, test for peroxides, and perform stabilization (if needed), maintain labeling and inventory records, request timely waste pickups, and provide hands-on training to other group members.

- Lab Personnel – All personnel working in a laboratory using PFCs must follow all procedures and guidelines described in this policy, report incidents, and comply with all other chemical and laboratory safety standards and guidelines.
- Environmental Health and Safety (EH&S) – Develops and maintains this PFC policy, provides hazardous waste training, conducts lab safety inspections, and picks up properly managed hazardous waste for disposal by an authorized vendor.
- Department Chairs – A Chair with departmental laboratories that use or store PFCs must understand the provisions of this policy and enforce compliance. When PFCs must be disposed of as high hazard waste due to improper management practices, the Chair must provide EH&S with a fund code to pay for any additional expenses. When high-hazard PFCs are identified, they must be disposed of in a timely manner.

Procurement and Inventory Management

- Purchase only quantities needed for immediate use (within 3 months for class A and 12 months for class B & class C, and 24 months for Class D) to minimize storage time. This reduces the risk of peroxide formation before use.
- Always purchase the inhibited forms of PFCs unless the procedure calls for a pure substance.
- Identify the PFC class (Appendix 1) of the chemical received and affix the corresponding color-coded PFC label (Appendix 2) on each container (round for small containers, rectangular for 1L or bigger containers). PRINT THESE LABELS IN COLOR.
- Write on the PFC label, the Received date, Opened date, manufacturer's Expiration date (if any) and the expected Disposal date based on the PFC class and intended use of the chemical (Appendix 3A/3B). Indicate if chemical is inhibited or not. Write all information on the PFC storage log for small containers.
- Maintain a chemical inventory in Campus Optics, including chemical name, quantity, location, and key dates for all peroxide formers (received date, opened date, manufacturer's expiration date, disposal date) to ensure timely disposal of each container.

Storage Guidelines

- Designate specific storage cabinets(s) or explosion-proof refrigerators for storage of PFCs. Post the following on the door of each storage location: PFC Storage log (Appendix 4), and the PFC quick reference guide (Appendix 5A & 5B).
- Place in secondary containment (e.g., trays) to prevent spills and segregate from other compatible non-peroxide formers.

- Store in tightly sealed, original containers (typically amber glass or metal) in cool (39-59 deg F), dry, well-ventilated areas away from heat, light, and ignition sources. Store under nitrogen or other inert gases if possible.
- Do not store aliquots in another container. Any amount taken out of the original container must be used immediately, and any excess must be disposed of as hazardous waste.
- Keep in mind that the shelf life of peroxide-forming chemicals depends on whether inhibitors are present and how the substances are stored. Typically, these chemicals lack a manufacturer's expiration date since producers cannot control or predict storage conditions once the chemicals are out of their hands.
- The storage and timeline of disposal indicated in Appendix 3A & 3B assumes that these PFCs are continually being stored in tightly sealed opaque containers, under inert atmospheric gases, and in a cool, dry place. If storage conditions deviate from these guidelines, always inspect the containers for signs of peroxide formation- white crystals or cloudy precipitate around the cap, neck, or surface of the liquid, yellow or brown discoloration, increased viscosity, liquid stratification, or pressure buildup. If there are signs of peroxide formation, do not disturb the container. Call EH&S immediately for assistance with disposal.
- Uninhibited class B should be treated as Class A for storage and disposal.
- Prohibited Storage: Do not store PFCs in refrigerators unless they are explosion-proof and labeled for chemical storage, to prevent accidental ignition/explosion.

Handling and Use Procedures

- Wear gloves, lab coat, safety goggles, and, if necessary, face shields and hearing protection when handling, especially for older containers.
- Use in a fume hood to minimize inhalation exposure, reducing health risks from potential vapors.
- Obtain aliquots from the original container in the amount that you will use immediately to avoid storage in improper containers (unsealed like beakers, volumetric flasks or containers with glass stoppers or metal lids). Any excess should be disposed of as hazardous waste according to Appendix 3A & 3B. Do not pour unused excess back into the original bottle. This will introduce trace impurities that may increase the rate of peroxide formation.
- Ensure that the lids are closed tightly before returning to storage cabinets.
- Practice good chemical hygiene to avoid cross-contaminating PFCs. Use glass and plastic equipment for handling (metal impurities can increase peroxide formation).

- Check for signs of peroxide formation (e.g., cloudiness, crystals, discoloration). Do not open containers past their expiration date without prior testing (Refer to Storage Guidelines) to avoid handling potentially explosive materials.

Testing for Peroxides

- Testing for peroxide is optional. You may choose to dispose of PFCs that test positive for peroxide formation as high-hazard waste (Refer to Disposal).
- Test for peroxide according to the PFC class and the testing schedule for each class. (Refer to Storage Guidelines).
- Use Quantofix 100 or EM Quant peroxide test strips (0-100 ppm range). Read the manufacturer's instruction for testing organic solvents for peroxides. Procedures typically require dipping the test strip, allowing it to dry, then adding distilled water to facilitate a reaction for peroxide detection.
- Ensure that the test strips are within their expiration date to guarantee accuracy. Strips typically have a shelf life of 3 years or more if stored properly. Store test strips in a cool, dry place, away from sunlight and moisture, to prevent degradation. Unopened containers can be refrigerated (36-46 deg F), but once opened, remove from the refrigerator and store them in a cool, dark, dry place.
- Open the container and remove only the strips needed at one time, then close the container immediately. Do not touch the test field as oils or contaminants can affect the reaction. Ensure the solution is at room temperature, as temperature can influence color development and accuracy.
- Use distilled water as Zero control and 3 ppm hydrogen peroxide as a positive control to verify the performance of the test strips. Always prepare the 3ppm hydrogen peroxide fresh on the day of the test.
- Review Appendix 6 for sample instructions on testing diethyl ether for peroxides using Quantofix 100. A similar instruction should be enclosed in the specific peroxide test strip that you purchased.
- Record test results on the peroxide test log (Appendix 7A for small containers) or a peroxide test label (Appendix 7B) that can be attached to large containers. Upload a photo of the test results for each container tested in Campus Optics (Container page, Add New Document on top right of the screen).

Disposal Procedures

- Hazardous waste disposal is regulated and governed by US Federal Law. It is unlawful to pour hazardous waste down the drain.
- Routine Disposal: The following can be disposed as routine hazardous waste: 1) unexpired, peroxide-free chemicals, or 2) neutralized and stabilized PFCs. Collect, store, and label hazardous waste containers according to our USC Hazardous Waste policy. Log in to Campus Optics to request hazardous waste pickup.
    - Stabilizing PFCs: PFCs that have formed peroxides at 30 ppm or less must be neutralized to <1% peroxide and then stabilized with an appropriate stabilizer while in their original container before they can be picked up as routine hazardous waste. Refer to Appendix 8 for the recommended neutralization and stabilization method. The following must be written on the container: the peroxide concentration before neutralization, final peroxide concentration, the substance used to stabilize the chemical, and the date of stabilization (e.g. <1 ppm peroxide, Stabilized with BHT, 4/2/25). Submit the containers for pickup in Campus Optics. Under the "additional information" field, provide the same information written on the container of stabilized PFC.
    - Any PFC must be both neutralized to <1% peroxide and stabilized with an appropriate stabilizer. Label with the additional information described above before requesting pickup as routine hazardous waste.
    - If the PFC either has more than 1% peroxide, has not been stabilized, or is not labeled as required, it will be picked up as high-hazard waste, and a disposal fee will be charged back to the Department.
- Expired PFCs Showing Signs of Peroxide Formation: Do not attempt to open or move containers with visible crystals, as they pose explosion risks. If there are visible crystals, visible precipitate, or an oily viscous layer present in the material, these are visual indicators of dangerously high peroxide levels. Do not disturb the containers and prevent others from doing so by clearly labeling the container as "High-hazard PFC, Do Not Touch". Contact EH&S immediately for professional disposal. The fee for this disposal will be charged back to the Department.
- PFCs Testing >30 ppm Peroxide: close the container and write the peroxide test result on the container (i.e. >30 ppm or 100 ppm). Label the container as "High-hazard PFC, Do Not Touch". Contact EH&S immediately for professional disposal. The fee for this disposal will be charged back to the Department.
- Spills: Clean up small spills using your spill kit and following recommended spill procedures. For larger spills (>200 ml), evacuate the area, post signage to prevent entry, and notify EH&S. Do not clean up large spills unless trained and equipped to do so to prevent exposure and further hazards.

Training Requirements

- All personnel handling peroxide-forming chemicals must complete the EH&S Chemical and Lab Safety and Hazardous Waste training to ensure awareness of risks and procedures.
- All personnel handling peroxide forming chemicals must sign and acknowledge in a signature page (Appendix 9) that they have reviewed and understand the contents of this policy and have discussed safe handling of peroxide-forming chemicals with their Principal Investigator.
- This policy covers identification, storage, handling, testing, disposal, and emergency procedures, to equip personnel on the proper management of peroxide-forming chemicals.

Emergency Procedures

- Fire/Explosion: Evacuate the area, activate the fire alarm, and call 911 for assistance. Call the USC Police at (803) 777-4215 for additional support.
- Exposure: Rinse the affected area with water for 15 minutes and seek medical attention immediately. USC Employees, with their Supervisor, must call CompEndium Services at 877-709-2667 to report the exposure and obtain a medical treatment plan.
- Reporting: Report all incidents to EH&S within 48 hours for investigation and preventive measures. Our laboratory incident report form can be downloaded here.

Compliance and Audits

- The Principal Investigator or a qualified designee will conduct a quarterly verification of all PFC containers. Use the following verification checklist:
    - Original label and PFC labels are intact.
    - If containers have been opened, the "Opened date" is recorded.
    - PFC storage log is up-to-date and includes every PFC in the storage cabinets.
    - Peroxide testing has been conducted, if required, and recorded on the container or the Peroxide Test log.
    - Container and liquid have no signs of peroxide formation or polymerization.
- EH&S Hazardous Waste staff will periodically conduct unannounced audits of storage, inventory, and disposal practices to ensure adherence to this policy.
- When PFCs are not properly managed, laboratories generate high-hazard PFC waste which incur additional costs. EH&S will dispose of all properly managed PFCs as routine waste, but is not responsible for payment of additional costs associated with safe opening, testing, stabilizing, and/or disposing of any PFCs that are not properly managed according to this policy. These expenses will be charged back to the department. Additionally, high-hazard PFCs must be disposed in a timely manner to mitigate risk of injury and property damage that may occur due to the potential explosion during handling of these materials.

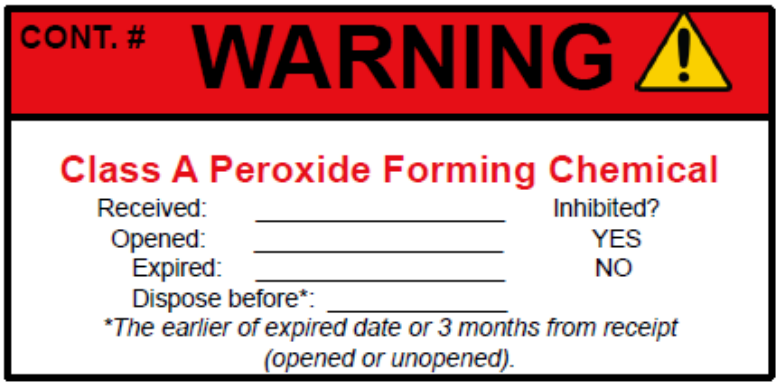
Contact Information

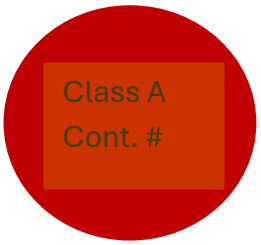
For questions about this policy, or for assistance with managing PFCs, contact:

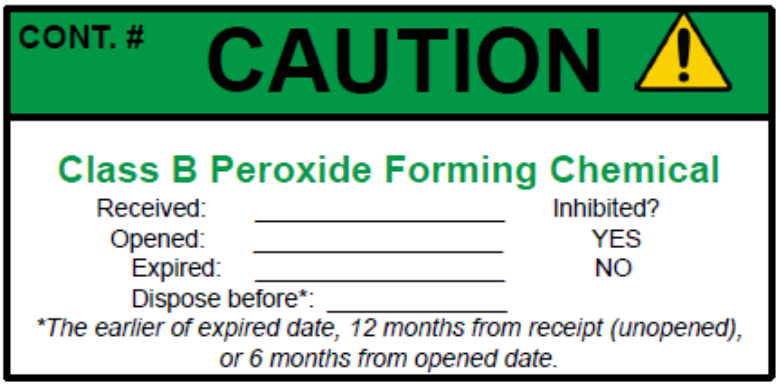
- Jocelyn Locke, EH&S Chemical Hygiene Officer, (803) 351-9874 or jlocke@mailbox.sc.edu
- Adam Roberge, EH&S ACHO, (803) 210-9644 or aroberge@mailbox.sc.edu
- David Estey, EH&S Hazardous Waste Manager, (803) 422-2122 or estey@mailbox.sc.edu

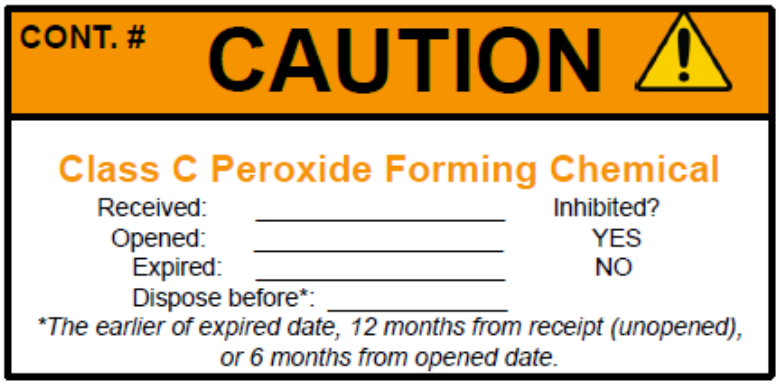
Appendix 1. List of peroxide-forming chemicals (adapted from University of Minnesota).

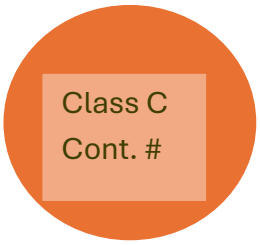
Appendix 2. PFC labels

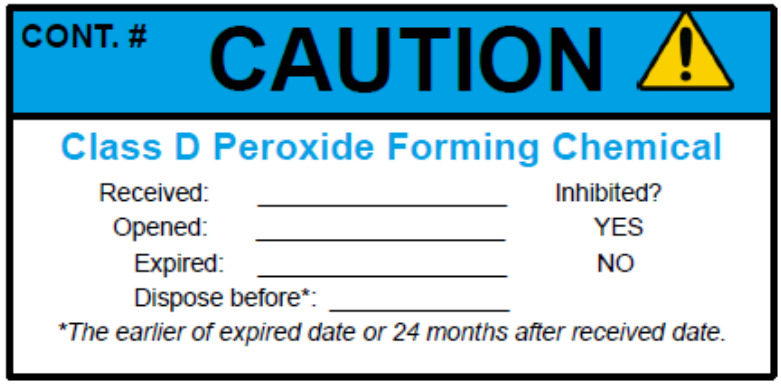


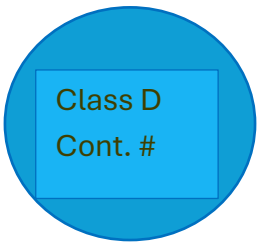












Appendix 3A. PFC Class A and B disposal schedule*.

PFC Class	Without Peroxide Testing		With Peroxide Testing
	Unopened Container (from Received date)	**Opened Container** (from Opened Date)	**Testing Frequency and Disposal Schedule** (Based on when container was opened and the peroxide test result)
A** (Purchase with inhibitors only) This class includes uninhibited Class B.	**within 3 months**	**within 3 months**	**Usually opened and used immediately due to very short shelf life. Dispose within 3 months of Received date.** Within the 3-month allowed storage, test for peroxides before each use. • If peroxide test shows ≤ 3 ppm – use with caution specially when heating/distilling. • If peroxide test shows >3 ppm peroxides, do not use the chemical. Immediately neutralize/stabilize or dispose as high-hazard waste by contacting estey@mailbox.sc.edu.
B** Purchase with inhibitors unless procedure requires pure substance. Use Class A schedule for uninhibited class B!	**within 12 months**	**within 6 months**	If opened within 1-3 months of Received date: • Test for peroxides @ 6th month of Opened date, then every 3 months thereafter. • If peroxide test shows ≤ 10 ppm – can be used for most procedures. If heating/distilling/evaporating, do NOT distill/evaporate to dryness. Always leave 20-30% residual volume. • If peroxide test shows >10-30 ppm - stabilize and then dispose as routine hazardous waste. • If peroxide test shows >30 ppm - write the test result and date tested and label the container as high-hazard PFC. Contact estey@mailbox.sc.edu for immediate disposal.
			If opened within 4-6 months of Received date: • Test for peroxides @ 3rd month of Opened date, then every 3 months thereafter. • Use or dispose of according to the peroxide test result described above.
			If opened within 7-11 months of Received date: • Test for peroxide before use, then every 3 months thereafter. • Use or dispose of according to the peroxide test result described above.
			If unopened after 11 months of Received date or approaching expiration date, DO NOT TEST FOR PEROXIDE. Submit a waste pickup request for disposal before the expiration date as routine hazardous waste. Dispose as high-hazard waste if there are signs of peroxide formation.

*Disposal schedule assumes proper storage guidelines are followed.
Follow manufacturer's expiration date if it comes first before the established disposal schedule based on Received date or Opened date.
** Always check the container/chemical for signs of peroxide formation before opening.

Appendix 3B. PFC Class C and D disposal schedule*.

PFC Class	Without Peroxide Testing		With Peroxide Testing
	Unopened Container	**Opened Container**	**Testing Frequency and Disposal Schedule** (Based on when container was opened and the peroxide test result)
****C** Purchase with inhibitors unless procedure requires pure substance.	Disposed within 12 months of Received date.	Dispose within 6 months of Opened date.	If opened within 1-3 months of Received date: • Test for peroxides @ 6th month of Opened date, then every 3 months thereafter. • When peroxide test shows ≤ 10 ppm – can be used for most procedures. If heating/distilling/evaporating, do NOT distill/evaporate to dryness. Always leave 20-30% residual volume. • When peroxide test shows >10-30 ppm - stabilize and then dispose as routine hazardous waste. • When peroxide test shows >30 ppm - write the test result and date tested and label the container as high-hazard PFC. Contact estey@mailbox.sc.edu for immediate disposal.
			If opened within 4-6 months of Received date: • Test for peroxides @ 3rd month of Opened date, then every 3 months thereafter. • Use or dispose of according to the peroxide test result described above.
			If opened within 7-11 months of Received date: • Test for peroxide before use, then every 3 months thereafter. • Use or dispose of according to the peroxide test result described above.
			If unopened after 11 months of Received date or approaching expiration date, DO NOT TEST FOR PEROXIDE. Submit a waste pickup request for disposal before the expiration date as routine hazardous waste. Dispose as high-hazard waste if there are signs of peroxide formation or polymerization.
D	Dispose within 2 years (24 months) of Received date.	Dispose within 2 years (24 months) of Received date or when peroxide test shows 30 ppm or above, whichever comes first.	If opened within 12 months of Received date: • Test for peroxides at 12 months after Opened date, then every 6 months thereafter. • Test before each use if heating, distilling, evaporating or subjecting to mechanical stress.

*Disposal schedule assumes proper storage guidelines are followed.

Follow manufacturer's expiration date if it comes first before the anticipated disposal schedule based on Received date or Opened date.

** Always check the container/chemical for signs of peroxide formation and polymerization before opening.

Appendix 4. PFC Storage Log

Container #	**Chemical Name**	**Initial Volume**	**PFC Class (A, B, C)**	**Inhibitor**	**Dates (if not on the container)**				**Verification Dates & Comments**
					Received	Opened	Expired	Dispose by	

Appendix 5A. Quick Reference Guide for Managing Peroxide-Forming Chemicals

Peroxide-forming chemicals (PFCs) can form unstable peroxides that pose explosion risks. Manage them by following safe storage and handling practices, testing for peroxides before high-hazard use, and adhering to disposal schedules.

Classification

Class	Description	Examples	Key Hazard
A	Severe peroxide hazard	Isopropyl ether, divinyl acetylene	Spontaneous peroxide formation
B	Peroxides form on concentration	Diethyl ether, THF	Explosive when concentrated
C	Peroxide-initiated polymerization	Styrene, butadiene	Polymerization risk
D	May form peroxides conditionally	Acetone, ethyl acetate	Lower risk, specific triggers

Disposal Schedule

Class	Without Peroxide Testing		With Peroxide Testing (see policy for PFC class-based schedule)
	Unopened	Opened	Opened
A	3 months	3 months	Within 3 months from receipt, test for peroxides before each use. If peroxide test is positive (any concentration) dispose of material as high-hazard waste through EH&S.
B	1 years	6 months	≤3 *ppm* – safe to use in any procedure. $> 3 - 10\ ppm$ – relatively safe to use for many procedures. When using for procedures that involve heat, evaporation, or distillation, do not evaporate to dryness! *>10-30 ppm* – neutralize and stabilize then dispose as routine hazardous waste. $> 30\ ppm$ – dispose as high-hazard waste by contacting estey@mailbox.sc.edu.
C	1 years	6 months	≤3 *ppm* – safe to use in any procedure. $> 3 - 10\ ppm$ – relatively safe to use for many procedures. When using for procedures that involve heat, evaporation, or distillation, do not evaporate to dryness! *>10-30 ppm* – neutralize and stabilize then dispose as routine hazardous waste. $> 30\ ppm$ – dispose as high-hazard waste by contacting estey@mailbox.sc.edu.
D	2 years	2 years	Within the storage period, test for peroxide before each use that involves heating, evaporation, distillation or mechanical stress.

Exceptions: Dispose by manufacturer's expiration if sooner; immediately dispose if there are signs of peroxide formation (crystals, discoloration, increased viscosity, gel formation, pressure).

Appendix 5B. Managing Peroxide-forming Chemicals (PFCs) Safely at USC

1. Purchase only what you will use within the next 3 months (Class A) and 12 (Class B and C). Include peroxide test strips (0-100 ppm scale) and the appropriate stabilizer with your chemical order.
2. Receive shipment of PFCs. Post the PFC Storage log on to the designated storage cabinet/refrigerator.
3. Enter each container's information into Campus Optics. (*Campus Optics will generate a unique number for each container, and the PFC class will be assigned to the chemical*).
4. Affix the appropriate colored PFC class label (round for small containers, rectangular for big containers) and write the corresponding container number on the label.
5. Enter all required container information into the PFC Storage log for the cabinet/refrigerator where the containers will be stored.
6. Write these dates on the PFC label (1L or bigger containers) or the PFC Storage log for smaller containers: Received date, Opened date, and Expiration date. Disposal date should be written on the label once the container is opened or peroxide tests are performed. (See policy for details on determining disposal dates).
7. Store the containers in designated storage cabinets or explosion-proof refrigerators if needing to be cooled. Storage cabinets should be away from heat, light, and moisture. Place in clearly labeled trays "Peroxide-forming Chemicals" when storage areas include other compatible non-peroxide forming chemicals. PFCs are <u>not</u> compatible with metals and oxidizers.
8. You will receive notifications from Campus Optics to verify the PFC containers quarterly. This is a reminder for you to inspect the containers and the storage cabinet to ensure that:
    - Original label and PFC labels are intact.
    - Containers that have been opened are labeled with the Opened date.
    - PFC storage log is up-to-date and accounts for every container in your storage cabinet.
    - Peroxide tests are recorded as applicable.
    - The container and liquid have no signs of peroxide formation or polymerization.
9. You are required to test for peroxides only if you are keeping your PFCs beyond the established without-testing disposal schedule (Appendix 2A/2B) and if you are using the chemicals for procedures that involve light, heating, evaporation, distillation, or mechanical stress. Follow the peroxide testing schedule in Appendix 2A/2B. Follow the peroxide test instructions that came with your peroxide test strip product. Ensure the strips are stored in a cool, dry place and are not expired before using.
10. Dispose of the following as routine hazardous waste (assuming they were stored properly, and the containers and chemicals do not show any signs of peroxide formation or polymerization):
    - Unopened containers within the manufacturer's expiration date.
    - Class A unopened and opened containers within 3 months of Received date.
    - Class B & C unopened containers within 1 year of Received date.
    - Class B and C opened containers within 6 months of Opened date but before 1 year of receipt.
    - Class B, C & D opened containers with peroxides that have been neutralized/stabilized.
11. Call EH&S immediately to dispose of the following and do not disturb these containers:
    - Containers that show signs of peroxide formation (crystals, discoloration, increased liquid viscosity, pressure buildup).
    - Containers that show signs of polymerization (thickening, gel formation, heat, cloudiness).
    - Class A that tested >3ppm for peroxides.
    - Class B, C & D that tested 30 ppm or more for peroxides.

Appendix 6. Peroxide Testing Instruction

Below is a stepwise procedure for testing diethyl ether for peroxides using Quantofix 100. *(Consult the document accompanying your peroxide test strips for specific instructions on how to use them).*

1. Test the efficacy of your peroxide test strips by dipping them in distilled water or *n*-hexane (negative control) and 3 ppm hydrogen peroxide (positive control, *should be prepared fresh each time*). The test strip should not turn blue in *n*-hexane while turning blue close to the 3 ppm blue on the color chart.
2. Pour a small amount of diethyl ether into a small beaker.
3. Open the container and remove only the number of strips needed for testing, then close the container immediately.
4. Do not touch the test field with your fingers.
5. Dip the test field end of the strips into the diethyl ether for 1 second.
6. Shake off excess liquids and wait 5 seconds.
7. Add a drop of distilled water onto the test field for accuracy of color development.
8. If hydrogen peroxide is present, the test field will turn blue.
9. Immediately compare the color of the test field to the color scale provided on the package (Quantofix 100 scale: 0, 1, 3, 10, 30, 100 ppm).
10. Record the value that matches closest with the colored test field.

Note: Color changes after 1 minute do not represent a positive reaction.

Note on Interferences:

- If the sample solution has a pH value of 2–9, the reaction will take place without interference.
- Strongly acidic solutions must be buffered with sodium acetate, and alkaline solutions with citric acid to a pH of 5–7.
- The presence of other strong oxidants will also lead to false results.

Appendix 7A. Peroxide test log for testing peroxides of PFCs in <1L containers.

Peroxide test label is available for 1L or bigger containers.

Container # (Campus Optics)	Chemical Name	PFC Class	Opened Date	Initial Test		Test 2		Test 3		Test 4		Test 5	
				ppm	date	*ppm*	date	*ppm*	date	*ppm*	date	*ppm*	date

Appendix 7B. Peroxide test label for 1L or bigger containers.

PEROXIDE TEST

Container # ________

	ppm	Date
Initial	____	____
2	____	____
3	____	____
4	____	____
5	____	____
6	____	____
7	____	____

STABILIZED: on (date) ____

Peroxide conc. before: ____

after: ____

Stabilizer/inhibitor: ____

PEROXIDE TEST

Container # ________

	ppm	Date
Initial	____	____
2	____	____
3	____	____
4	____	____
5	____	____
6	____	____
7	____	____

STABILIZED: on (date) ____

Peroxide conc. before: ____

after: ____

Stabilizer/inhibitor: ____

PEROXIDE TEST

Container # ________

	ppm	Date
Initial	____	____
2	____	____
3	____	____
4	____	____
5	____	____
6	____	____
7	____	____

STABILIZED: on (date) ____

Peroxide conc. before: ____

after: ____

Stabilizer/inhibitor: ____

PEROXIDE TEST

Container # ________

	ppm	Date
Initial	____	____
2	____	____
3	____	____
4	____	____
5	____	____
6	____	____
7	____	____

STABILIZED: on (date) ____

Peroxide conc. before: ____

after: ____

Stabilizer/inhibitor: ____

Appendix 8. Methodology for Stabilizing PFCs with Peroxides

Objective

To safely reduce or eliminate peroxides in peroxide-forming chemicals, and prevent detonation risks during handling, storage, or disposal.

Scope

This methodology applies to chemicals identified as peroxide formers (Appendix 1A and 1B) where testing shows a peroxide level of 30 ppm or less. It assumes stabilization is only conducted by trained personnel in appropriate laboratory facilities.

Key Principles

- Safety First: Peroxides are shock-, heat-, and friction-sensitive; minimize disturbance.
- Testing: Confirm peroxide levels before and after stabilization to ensure success.
- Professional Oversight: High peroxide levels (≥100 ppm) or visible crystals will require expert intervention. Do not move or disturb the bottle.

Materials and Equipment

- Personal Protective Equipment (PPE): Chemical-resistant gloves, lab coat, safety goggles, face shield, blast shield (if handling concentrated peroxides).
- Peroxide Test Strips or Reagents: For semi-quantitative detection (e.g., strips sensitive to 1-100 ppm).
- Reducing Agents: Ferrous sulfate ($FeSO_4$), sodium bisulfite ($NaHSO_3$), or sodium metabisulfite ($Na_2S_2O_5$), depending on chemical compatibility.
- Solvents: Water or compatible organic solvent (e.g., ethanol) for dilution.
- Glassware: Acid-washed glass containers (avoid metal, which can catalyze reactions).
- Ventilation: Fume hood with adequate airflow.
- Emergency Supplies: Spill kit, fire extinguisher, eyewash station, emergency shower.

Step 1: Initial Assessment

1. This method may be performed only on PFC containers that are dated (Received date and Opened date) and have had an initial peroxide test within 6 months of opening and periodic tests every three months thereafter.
2. This method is designed for neutralizing and stabilizing 1 L or less of PFC.
3. You are reading this procedure because your most recent test showed a peroxide level of 30 ppm or less. Make sure that you record this test result and the test date preferably on the chemical container or the peroxide test log for small containers.
4. You are about to stabilize the peroxides that have formed so that you can dispose of the chemical as a routine hazardous waste. Keep in mind that you can choose not to stabilize this material and request a high-hazard waste pick-up by emailing estey@mailbox.sc.edu . This will incur a disposal fee to be determined by EH&S.

Step 2: Risk Evaluation

- Low Levels (≤10 ppm): Safe to stabilize in-house with basic precautions.
- Moderate Levels (10-30 ppm): Requires careful stabilization by Lab Personnel with proper training and experience under controlled conditions.
- High Levels (>30-100 ppm): Requires careful stabilization by EH&S under controlled conditions.
- Very High Levels (>100 ppm) or Crystals: Stop. Do not proceed without EH&S or hazardous waste specialists, as these containers pose an explosion risk.

Step 3: Preparation

1. Set Up Workspace:
    - Work in a fume hood behind a blast shield.
    - Ensure all equipment is grounded to prevent static sparks.

Step 4: Neutralization and Stabilization Process

1. Select Reducing Agent:
    - Ferrous Sulfate ($FeSO_4$): Effective for ethers like diethyl ether or THF. Prepare a 10% aqueous solution.
    - Sodium Bisulfite ($NaHSO_3$): Suitable for aldehydes, ketones, and vinyl ether. Use a 5-10% solution.
    - Confirm compatibility with the specific chemical (e.g., avoid reducing agents that react with the parent compound).

2. Application:
    - Slowly add the reducing agent to the chemical while stirring gently with a glass rod.
    - Monitor for heat or gas evolution—stop if excessive reaction occurs.
    - Let the mixture sit for 1-2 hours to ensure peroxide reduction.
3. Neutralization Check:
    - Retest with peroxide strips. Repeat treatment until peroxide test strip does not turn blue.
4. Add an appropriate inhibitor to stop new formation of peroxides. Add the same inhibitor that was originally added by the manufacturer.
    - For ethers like diethyl ether and THF: add 100-250 mg of butylated hydroxytoluene
    - For alkenes or vinyl compounds like cyclohexene add 25-100 mg of hydroquinone
    - For secondary alcohols like 2-propanol: add 100-300 mg butylated hydroxy toluene

Step 5: Post-Stabilization

- Label the container with the type of stabilizer added and stabilization date.
- Upload a photo of the labeled stabilized container to campus optics
- Record the final peroxide concentration (<1 ppm) on the Peroxide Test log.
- Record stabilization method and disposal date on the PFC Storage log.
- Dispose of material as routine hazardous waste within 1 month.
- Decontaminate glassware used in the procedure with a mild acid wash (e.g., dilute HCl) to remove residual peroxides, then rinse thoroughly.

Safety Precautions

- Avoid shaking, heating, or friction, as peroxides can detonate.
- Test a small aliquot (e.g., 10 mL) first to confirm the reducing agent's effectiveness before scaling up.
- If the container shows signs of instability (e.g., heat, fizzing), evacuate and contact EH&S.

Appendix 9. PFC Policy Acknowledgement

The undersigned agree to the following statements:

"The USC Policy for Managing Peroxide-forming Chemicals has been reviewed with the personnel listed below. I confirm that they have been informed of all guidelines and requirements concerning the procurement, storage, handling, and disposal of peroxide-forming chemicals as detailed in the policy. I am familiar with these guidelines and requirements and pledge to fully comply with them".

Title	Printed Name	Signature and Date
Principal Investigator:	_____	_____
PFC Manager:	_____	_____

"I have been informed about the contents of the USC Policy for Managing Peroxide-forming Chemicals. I understand all the guidelines and requirements related to the procurement, storage, handling, and disposal of peroxide-forming chemicals as outlined in the policy. I confirm my commitment to adhere to all these guidelines and requirements".

	Printed Name	Position	Signature and Date
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
11.	_____	_____	_____
12.	_____	_____	_____

Insert additional signature page as necessary.