UCI Environmental Health & Safety

Standard Operating Procedure (SOP)

This Standard Operating Procedure (SOP) describes basic chemical safety information for organic peroxides & self-reactive chemicals. Prior to conducting work with organic peroxides & self-reactive chemicals personnel must obtain approval from their Principal Investigator (PI) and/or Supervisor and attend the appropriate laboratory safety training. The PI must complete the Lab-Specific Use Procedures section and provide their personnel with a copy of this SOP and a copy of the SDS from the manufacturer.

Organic Peroxides & Self-Reactive Chemicals

Date SOP was written:	
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	
Principal Investigator Signature:	

Type of SOP: ☐ Process ☐ Hazardous Chemical [X] Hazardous Class

Purpose

The purpose of this standard operating procedure is to acquaint you with the proper and safe handling, use, storage, and disposal of organic peroxides & self-reactive chemicals.

Properties & Hazards

Chemicals in this band are thermally unstable and may undergo exothermic self-accelerating decomposition. In addition, they may also be explosive, burn rapidly, be sensitive to impact or friction, and react dangerously with other substances. All chemicals in this band are considered highly hazardous.

The GHS and Cal/OSHA definition of the band is described in the table below:

GHS Pictogram	UCI Hazard Level	GHS Category	GHS H-Code	Cal/OSHA Definitions
	Highly Hazardous	Organic Peroxides (Types A, B, C, D, E, F)	H240, H241, H242	Organic Peroxides
		Self-Reactive Substances (Types A, B, C, D, E, F)	H240, H241, H242	Unstable (reactive)

Personal Protective Equipment (PPE)

Skin and Body Protection:

A flame resistant Nomex® lab coat, long pants (or equivalent) completely covered legs, and closed toed shoes.

Hand Protection:

Choose gloves that provide a balance between protection against chemical exposure, lacerations (in case of an explosion), and the dexterity required for working with organic peroxides & self-reactive compounds.

Nitrile or neoprene gloves are typically adequate for minor splashes. Consult the SDS and/or your PI to determine whether the material or process requires alternative hand protection.
If there is a high risk of fire, fire-resistant hand protection should be worn, including a chemical resistant outer glove (neoprene) over an approved fire-resistant (Nomex®) inner glove/liner.

Eye Protection:
ANSI Z87.1-compliant safety glasses or safety goggles if a splash hazard is present. The use of a face shield over safety glasses and a blast shield are strongly recommended, even when working in front of a fume hood sash due to the potential shattering in the event of an explosion.

Administrative Controls

- Never work alone with organic peroxides and self-reactive chemicals. Inform all other personnel in the laboratory before working with these chemicals.
- Prior to beginning work, determine the initiating mechanism that could lead to an explosion such as friction, impact, catalysts, light, or heat. Refer to the SDS for this information.
- Use equipment that cannot generate static electricity or sparks.
- Explore alternative strategies with your PI before working with organic peroxides and self-reactive chemicals.
- The PI and/or supervisor must communicate and enforce clear limits on the quantity of each organic peroxide and self-reactive chemical that can be used in a single experiment.
- Reduce the quantity of organic peroxide and self-reactive chemicals that you work with and store. Buy Less, Store Less, and Use Less. Dispose of unused or unwanted compounds.
- Any work with Class A organic peroxide chemicals must be pre-approved by the Principal Investigator prior to use.
- Review the Safety Data Sheets (SDSs) for all chemicals used in the experiment. Online SDSs can be accessed at https://ehs.uci.edu/sds/index.php.

Engineering Controls

Fume Hoods:
All reactions involving organic peroxides and self-reactive chemicals must be conducted in a fume hood. Keep the fume hood sash closed while the reaction is in progress. Do not linger unnecessarily in front of the fume hood where organic peroxides and self-reactive chemicals are in use.

Blast Shields:
All work with organic peroxides and self-reactive chemicals must be carried out in a fume hood with the addition of a blast shield, in the event of a violent explosion the fume hood safety glass may shatter and blow outward. Place the blast shield between yourself and the reaction so you can reach around.

Special Storage and Handling Requirements

Always follow the manufacturer's recommendations for storage and handling. Following recommended storage and handling practices can effectively reduce the risk of fires and explosions.

Storage:

- Keep and store away from all ignition sources such as heat, sparks, light, flames, incompatible materials, and any potential initiators. Protect from shock, friction, and physical damage.
- Glass containers with screw-cap lids or glass stoppers may not be acceptable for organic peroxides, especially those sensitive to friction or grinding.
- Do not store organic peroxides that give off gas as they decompose in a tightly sealed, non-vented container. The buildup of gas pressure could rupture the container. These peroxides are shipped in containers with specially vented caps that relieve the normal buildup of gas pressure that could shatter an unvented container. Check vent caps regularly to ensure that they are working properly. Never use other types of caps for containers of these organic peroxides. Keep vented containers in an upright position.
- If a water-based formulation freezes, do not chip or grind it to break up lumps of material, or heat it to thaw it out. Follow the chemical supplier's advice.
- Limit the amount stored to only the amount needed for planned experiments.
- Always use compatible materials for storage, transfer, etc.

Handling:

- Consult with your PI the first time you run a reaction or anytime you make a change.
- Always follow a published procedure, if the procedure is over 20 years old, find a more recent related procedure that more adequately addresses safety issues.
- Always run the first reaction on a small scale.
- Allow for gas evolution. Never seal organic peroxides and self-reactive chemicals in a closed metal vessel.
- Add organic peroxides and self-reactive chemicals to solutions of catalysts (not the reverse). Be cautious when mixing organic peroxides or self-reactive chemicals with potential catalysts.
- Run reactions at the lowest temperature possible. Never heat a reaction unless it is known safe to do so. If a reaction requires heat, slowly increase the temperature.
- Handle organic peroxides and self-reactive chemicals behind a blast shield.
- Use containers and tools/supplies/equipment made from non-metal materials and which are compatible with the peroxides used. Keep them very clean to avoid contamination.
- Dilute organic peroxides & self-reactive chemicals strictly in according to the chemical supplier's advice. Using the wrong solvent or a contaminated solvent could cause an explosion (e.g. methyl ethyl ketone peroxide and cyclohexanone peroxide may explode if they are mixed with acetone, a common solvent). Always use fresh solvent, using reclaimed solvents of uncertain composition can also be hazardous. They may contain dangerous concentrations of contaminants that are incompatible with the organic peroxide or self-reactive chemical.
- Conduct distillation, extraction or crystallization, and other processes that concentrate the organic peroxides and self-reactive chemicals only when it is explicitly known safe to do so. Filtering friction-or shock-sensitive chemicals with materials and devices that produce heat, such as sintered glass filters, can also be hazardous. If the reactivity is not known but these processes must be done, conduct these activities as if the organic peroxide or self-reactive chemical is an explosive.
    - Never put solutions of organic peroxides and self-reactive chemicals on a rotary evaporator.
- Do not let combustible solids (e.g. paper towels and lab coats) become contaminated with organic peroxides. Should this happen, immediately soak and rinse with water to remove the organic peroxide.

Spill, Accident, and First Aid Procedures

Spills:
Refer to the spill response flowchart. Notify others in the area of the spill. Evacuate and prevent access to the location where the spill occurred. Notify your supervisor and EHS at x4-6200 immediately.

Skin or Eye Contact:
Remove contaminated clothing or contact lenses and flush the affected area with water for at least 15 minutes. Obtain medical attention immediately.

Inhalation:
Move to fresh air. Obtain medical attention immediately.

Ingestion:
Obtain medical attention immediately. (The poison control center, (800) 222-1222, is available 24 hours every day).

Waste Disposal Procedure

Stabilization of organic peroxides and self-reactive chemicals (dilution):

- Any formulation of explosive molecules farther apart will reduce the potential for an explosion. The more unstable the molecule, the more dilution is required to render it safe.
- Dilute organic peroxides & self-reactive chemicals strictly in according to the chemical supplier's advice. Using the wrong solvent or a contaminated solvent could cause an explosion (e.g. methyl ethyl ketone peroxide and cyclohexanone peroxide may explode if they are mixed with acetone). Always use fresh solvents, using reclaimed solvents of uncertain composition can also be hazardous. They may contain dangerous concentrations of contaminants that are incompatible with the organic peroxide or self-reactive chemical.

Decontamination:

- Decontamination methods will vary based on the materials being handled and the equipment being used. Please review the SDS for guidance on decontamination.

Disposal:

- Hazardous waste must be transferred to EHS for disposal within 6 months of being generated.
- Hazardous Waste Disposal
    - Send a text message Text a pick up to hwp@uci.edu, EHS will pick up your waste within 1-3 days
    - Or visit https://ehs.uci.edu/enviro/haz-waste/

Additional Information

For additional information about handling organic peroxides & self-reactive chemicals refer to

- Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards. Section 6.G. Working with Highly Reactive or Explosive Chemicals (https://nap.nationalacademies.org/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical).

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APPENDIX A:
Lab-Specific Use Procedures

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

Please see the General Information for ***Hazardous Materials Standard Operating Procedure*** for specific instructions on writing lab-specific use produces.

Add a generic process/procedure on the safe use of the chemicals within this band.

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Documentation of Training

Prior to conducting any work with organic peroxides & self-reactive chemicals, designated personnel must provide training to their laboratory personnel specific to the hazards and procedures involved in working with these substances.

I have read and understand the content of this SOP:

Name	Signature	Date