Laboratory Specific Standard Operating Procedures

TITLE: SOP for the safe use and management of Peroxide-forming Chemicals

Date: Review: Date Revised:

Principle Investigator:

Authors (Names):

Department, Building, Room(s):

Contact Phone Number:

This SOP must be kept on file for all laboratory employee training and review.

Section 1: (Check One)
There are three methods that can be used to write SOPs. They are: by process (distillation, synthesis, chromatography, etc.); by individual hazardous chemical (benzene, phenol, arsenic, etc.); and by hazardous chemical class (flammable, corrosive, oxidizer, etc.).

_____ Process ___X__ Chemical _____Hazard Chemical Class

Section 2: Describe Process, Hazardous Chemical or Hazard Class
This SOP presents guidelines and procedures for use of general peroxide-forming chemicals, such as ethyl ether and tetrahydrofuran. The SOP should be edited specifically for each peroxide-forming chemical used and stored. In addition to use of this SOP, persons working with Peroxide-forming chemicals should be thoroughly familiar with general guidelines for high hazard chemicals identified in the High Hazard Chemical Policy (EHS 200.09) and all other applicable LSUHSC chemical safety policies. All current applicable MSDSs should be available and reviewed prior to use.

Peroxide-forming chemicals are a class of compounds that have the ability to form shock-sensitive explosive peroxide crystals. Peroxides are formed through a spontaneous reaction with oxygen. Simply opening the container can initiate peroxide formation, while light and heat can act to accelerate the process.

Unless these materials are properly handled they can pose a serious safety hazard to users and become a difficult disposal problem for the Environmental Health and Safety Department.

Therefore, it is extremely important that this procedure be followed regarding the identification, storage, handling, testing and disposal of peroxide-forming chemicals.

There are three classes of peroxide-forming chemicals, based upon the peroxide formation hazard:

- **Class A:** Chemicals that form explosive levels of peroxide without concentration. These are the most hazardous and can form explosive peroxide levels even without the container being opened. The Class A peroxide forming chemicals list is as follows: Divinyl Acetylene, Divinyl Ether, Isopropyl Ether, Sodium or Potassium Amide, Vinylidene Chloride (1,1-dichloroethylene)

- **Class B:** Chemicals that form explosive levels of peroxides when concentrated through distillation, evaporation or exposure to air after opening. The Class B peroxide forming chemicals list is as follows: Acetal, Butadiene, Cellosolve, Cumene (isopropyl benzene), Cyclohexene, Cyclopentene, Decalin, Diacetylene (gas), Dicyclopentadiene, Diethyl ether (ether), Dioxane, Ethylene glycol dimethyl ether (glyme), Ethylene glycol ether acetates, Furan, Methyl Isobutyl Ketone, Methyl Acetylene (gas), Methyl Cyclopentane, Tetrahydrofuran (THF), Tetralin (tetrahydronaphthalene), Vinyl ethers.

- **Class C:** Chemicals which are a hazard due to peroxide initiation of polymerization. The Class C peroxide forming chemicals list is as follows: Acrylonitrile, Chlorobutadiene, Chloroprene, Chlorotrifluoroethylene (gas), Methyl Methacrylate, Styrene, Tetrafluoroethylene (gas), Vinyl Acetate, Vinyl Acetylene (gas), Vinyl Chloride (gas), and Vinyl Pyridine

The general safety and health hazards and recommended work practices and controls associated with most peroxide-forming chemicals are below. The specific potential safety and health hazards, outside of their general ability to form peroxides, associated with each peroxide-forming chemical will vary with each chemical. The chemical specific MSDS should be reviewed prior to their use to determine the specific hazards and recommended work practices and controls.

Section 3: Potential Hazards

Physical Hazards

- Peroxide-forming chemicals are generally flammable.
- May form explosive peroxides.

Health Hazards

- Contact with eyes may cause severe irritation, redness, pain and possible eye burns.
- Prolonged exposure to high concentrations of vapor may cause eye damage. Contact may cause ulceration of the conjunctiva and cornea. Damage may be permanent.
- May cause skin irritation. Prolonged and/or repeated contact may cause dermatitis. May be absorbed through skin.
- Harmful if swallowed. May cause gastrointestinal irritation with nausea, vomiting and diarrhea. Ingestion of small amounts of certain peroxide forming chemicals may be fatal.

- Inhalation of high concentrations may cause central nervous system effects. Causes respiratory tract irritation. Continued exposure may lead to nausea, headache, dizziness, unconsciousness, coma and death.

Section 4: Personal Protective Equipment

- Proper Laboratory Attire - pants or dresses/shorts below the knees, sleeved shirt, close-toe shoes
- Lab Coat - fully buttoned lab coat with sleeves extending to the wrists. Coat should be laundered if it becomes contaminated.
- Eye/ Face Protection
  - At a minimum, safety glasses with side shields will be used when handling these chemicals. Goggles or face shields must be worn during operations with potential exposure to vapors/mist or a high liquid splash potential, and during procedures such as heating, evaporation and distilling.
  - Ordinary (street) prescription glasses do not provide adequate protection.
- Hand Protection
  - Disposable nitrile gloves. Change gloves frequently and when contaminated, punctured or torn.
  - Laboratory personnel should thoroughly wash hands with soap and water before and immediately upon removal of gloves.
- Respiratory Protection - If potential for inhalation exposures are anticipated/suspected, contact EH&S (568-6585) for consultation.

Section 5: Engineering Controls

- Identify and use safer chemical alternatives (e.g., non-peroxide forming chemicals or lower hazard peroxide former). Otherwise, procure chemicals that have a peroxide inhibitor added (e.g., BHT).
- If peroxide-forming chemicals must be used, purchase only those quantities that are expected to be used within the expiration and required disposal timeframes.
- A chemical fume hood must be used when handling peroxide-forming chemicals in a manner that may produce an airborne hazard (such as fumes, gases, vapors, and mists). This includes procedures such as transfer operations, preparation of mixtures, blending, sonification, spraying, heating, evaporation and distilling.
- Work at least 6" inside of hood and set sash at lowest possible position
- Leave at least 10% bottoms (liquid volume) when distilling peroxide-forming chemicals
- Carry out distillation activities behind shields.

Section 6: Special Handling and Storage Requirements

The following precautions and procedures shall be taken when handling peroxide-forming chemicals.

- The quantity of chemical stored and used shall be limited to the minimum amount required. Unused chemical shall not be returned to the container.
- Label each container with a standard peroxide warning label. The label identifies the Date Received, Date Opened, and Date Last Tested and test result. Labels are available from EH&S. When applying the label, do not cover or otherwise deface the original manufacturer's label.

- Keep chemical containers tightly closed, as oxygen is required for the formation of peroxides.
- Use peroxide-forming compounds on a first-in, first out basis.
- Store away from heat and light.
- To minimize the rate of decomposition, store at the lowest possible temperature consistent with their solubility or freezing point. Liquids or solutions of peroxides shall not be stored at or lower than the temperatures at which the peroxides freeze or precipitate because peroxides in these forms are extremely sensitive to shock and heat.

Container/Material Inspection

Upon initial opening of the container and prior to routine testing, which is performed on a basis as defined by the class specific requirements identified below, check materials for visible peroxide formation. Adhere to the following guidance and inspection result requirements:

- Peroxide crystals tend to form on the inner surfaces of the container. Indications of peroxide formation include visible crystals or discoloration or stratification of the liquid (discoloration of solids).
- Peroxide crystals may form on the container plug or the threads of the lid and detonate when the lid is twisted. **Do not open a liquid organic peroxide or peroxide-forming chemical if crystals or a precipitate are present.**
- **If visible indicators are identified, do not handle the chemical any further and submit request to EH&S for immediate disposal.**

Peroxide Testing

Testing for peroxides shall be performed for chemicals which demonstrate no visible indications of peroxide formation. Testing can be performed for most peroxide-forming organic solvents, unless otherwise indicated through the MSDS or other literature/guidance document. Peroxide test strips detect organic compounds that contain a peroxide or hyperperoxide group. A recommended test strip is the EMQuant® Peroxide Test Strip (0-100 ppm range).

- Testing should NOT be applied to materials that may be contaminated with inorganic peroxides, such as metallic potassium. Contact EH&S for consult on testing for inorganic peroxides.
- Never test containers of unknown age or history; report these to EH&S immediately.

The following are the storage duration and testing frequency requirements for each of the three classes of peroxide forming chemicals:

Class A:

The maximum storage time of an unopened and untested Class A chemical container shall be 6 months. All unopened Class A chemical containers shall be opened and tested no later than 6 months subsequent to receipt of the material. All Class A materials must be disposed of within 1 year of receipt, regardless of whether opened and test results.

Class B/C:

The maximum storage time of an unopened and untested chemical Class B/C chemical containers shall be 1 year. All unopened Class B/C chemical containers shall be opened and tested no later than 1 year subsequent to receipt of the material.

Test Result Interpretation Guidelines

- If the test indicates >80 ppm peroxides = submit for disposal.

- If the test indicates <80 ppm peroxides = retest every 3 months and dispose when the test indicates >80 ppm peroxides, or when the manufacturer expiration date is reached.
- All materials with test results above 80 ppm should be considered a potentially explosive material and not handled further. In these cases, EH&S should be contacted immediately at 568-6585 to facilitate removal and disposal.

Section 7: Spill and Accident Procedures

- The availability, location, and contents of an appropriate chemical spill clean-up kits must be confirmed prior to handling or beginning any work with peroxide-forming chemicals.
- Immediately notify all lab personnel of spills (with the details of the spill and actions being taken) and regulate access to the area.
- Laboratory personnel should be prepared to manage a spill or accident involving these chemicals according to the MSDS specific recommendations and the guidance provided in LSUHSC Chemical Spill Response Procedure (EHS 200.02).
- However, the following general practices shall be used when managing a spill or accident involving all peroxide-forming chemicals:
  - Remove all sources of ignition from the area
  - Never use combustible or reactive materials (such as paper towels) to clean up or absorb spills of peroxide formers. Typically, inert materials, such as kitty litter, vermiculite, sand, are best for absorbing these chemicals.
  - Do not allow clean-up materials to dry– seal them inside a clear plastic bag.
- Personnel cleaning the spill shall, at minimum, wear the same PPE required for handling/use.
- In the event of skin contact, immediately remove contaminated clothing and wash affected areas with soap and copious amounts of water.
- In case of contact with eyes, immediately flush with copious amounts of water for at least 15 minutes and subsequently obtain medical attention.
- All exposed persons should seek immediate medical attention (subsequent to initial decontamination for skin contact).
- Report all spills, regardless of size, to laboratory PI, who will report to LSUHSC EH&S.

Section 8: Decontamination Procedures

- Where the eyes or body of any person may be exposed to peroxide-forming chemicals, a safety shower/eye wash must be available for immediate use. Personnel must be aware of location of nearest Safety Shower/ Eye Wash and verify that a current certification of performance tag is present.
- Personnel shall rinse any exposed areas of skin and/or eyes with copious amounts of water for at least 15 minutes.

Section 9: Waste Disposal Procedures

The waste generated as the result of peroxide-forming chemicals is considered hazardous and must be disposed of in accordance with LSUHSC Chemical Waste Management Procedures (EHS 200.04).

Section 10: Laboratory Specific Protocol(s):

Attach laboratory protocol for specific handling and operational practices.