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| Chemical: ***Peroxide Forming Chemicals - PFC’s and Organic Peroxides*** | Print Date: |
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# Purpose

Organic peroxides are a special class of compounds that have unusual stability problems, making them among the most hazardous substances normally handled in laboratories .

Chemicals that are susceptible to peroxide formation are ones that typically react with air, moisture or impurities and produce a change in their chemical composition in normal storage. Certain organic solvents are susceptible to peroxide formation and can become extremely sensitive to thermal or mechanical shock and may explode violently. 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 also become dangerous for the EH&S staff during waste pick-up.

Manufacturers may add an inhibitor to peroxide forming chemicals to counter peroxide formation. For many peroxide-forming solvents, butylated hydroxyl toluene (BHT) is commonly added. BHT scavenges oxygen in the solvent and prevents it from reacting with the solvent to form peroxides. Over time, BHT or other inhibitors in the solvent can become exhausted allowing peroxides to form. Distilling the solvent can completely remove the BHT or inhibitors and make the solvent immediately susceptible to peroxide formation.

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# Physical & Chemical Properties/Definition of Chemical Group

**Class 1:** These chemicals form peroxides after prolonged storage. These chemicals should be tested for the formation of peroxides on a periodic basis.

Examples: Divinyl Acetylene, Divinyl Ether, Isopropyl Ether, Sodium or Potassium Amide, Vinylidene Chloride (1,1-dichloroethylene), Potassium metal

**Class 2:** Chemicals that form explosive levels of peroxides when concentrated through distillation, evaporation or exposure to air after opening.

Examples: 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 3:** Chemicals which are a hazard due to peroxide initiation of polymerization. When stored in a liquid state, the peroxide forming potential increases significantly.

Examples: Acrylic acid, Acrylonitrile, Butadiene, Chlorobutadiene, Chloroprene, Chlorotrifluoroethylene (gas), Methyl Methacrylate, Styrene, Tetrafluoroethylene (gas), Vinyl Acetate, Vinyl Acetylene (gas), Vinyl Chloride (gas), Vinyl Pyridine, Vinylidene chloride.

**Examples of Organic Peroxides:** Benzoyl peroxide, Butyl Peroxydicarbonate Cyclohexanone Peroxide, Methyl Ethyl Ketone Peroxide, Methyl Isobutyl Ketone Peroxide

# Potential Hazards/Toxicity

Potential Health Effects:

Eye: 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.

Skin: May cause skin irritation. Prolonged and/or repeated contact may cause dermatitis. May be absorbed through skin.

Ingestion: Harmful if swallowed. May cause gastro-intestinal irritation along with nausea, vomiting and diarrhea. Ingestion of 1 or 2 ounces of ethyl ether may be fatal.

Inhalation: 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.

Routes of Exposure

May enter the body through all routes of exposure.

Chronic Effects:

Prolonged or repeated eye contact may cause conjunctivitis. Prolonged or repeated skin contact may cause defatting and dermatitis. May cause liver and kidney damage.

Repeated exposures may be habit forming. Prolonged exposures may result in headache, drowsiness, excitation, and psychic disturbances. Teratogenic effects are possible.

Aggravation of Pre-existing Conditions

Persons with pre-existing skin disorders or eye problems or impaired liver, kidney or respiratory function may be more susceptible to the effects of this substance. Alcoholic beverage consumption can enhance the toxic effects of this substance.

# Personal Protective Equipment (PPE)

* Nitrile disposable gloves. Change gloves frequently and when contaminated, punctured, or torn. Wash hands immediately after removing gloves.
* Use chemical safety goggles and/or a full face shield where splashing may occur.
* A laboratory coat should be worn when working with this chemical. Impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
* Closed toe shoes are required at all times when working in the laboratory. Shoes should be conductive and nonsparking.
* Facilities storing or utilizing this material must be equipped with an eyewash facility and a safety shower.

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# Engineering Controls

* Work in a chemical fume hood is generally required because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area.
* Use adequate ventilation to keep airborne concentrations low.

# First Aid Procedures

Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Skin Contact: Wipe off excess material from skin, then immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention immediately.

Ingestion: Do not induce vomiting. If victim is conscious and alert, give large quantities (2-4 cups) of milk or water. Never give anything by mouth to an unconscious person. Get medical attention immediately. Wash mouth out with water.

Inhalation: Remove from exposure and move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention immediately.

# Special Handling and Storage Requirements

* + Minimize the quantity of peroxides or peroxide forming chemicals (PFCs) in the lab.
	+ Try to avoid over ordering of PFCs that will not be used within the allotted time.
	+ Know the properties and hazards of all chemicals you are using through adequate research and study, including reading the label and MSDS.
	+ Carefully review all cautionary material supplied by the manufacturer prior to use.
	+ Store all peroxide forming chemicals in tightly closed, air-impermeable, light-resistant containers, away from heat, light, direct sunlight, static electricity, sources of ignition, oxidizers and oxidizing agents. Segregate these compounds from other classes of

chemicals that could create a serious hazard to life or property should an accident occur (i.e. acids, bases, oxidizers, etc.)

* + Label each container with the Date Received, and Date Opened.
	+ Make sure caps are replaced promptly after use. Store in the original manufacturer’s container whenever possible. Protect containers from shock, friction, and do not shake.
	+ Immediately rinse empty containers that once held peroxide-forming solvents. Do not allow residues to evaporate. Do not attempt to open or rinse a container of unknown age and history; report these containers to EHS office immediately.
	+ Never return unused quantities back to the container (contamination).
	+ Wear proper personal protective equipment, including safety eye wear and face shields.
	+ Clean up all spills immediately.
	+ Avoid evaporation or distillation, since distillation defeats the stabilizer added to the solvents.
	+ If solids or crystals are observed or visibly present on or in the container or lid, or if the chemical shows discoloration, string-like formation, or liquid stratification, DO NOT OPEN OR MOVE THE CONTAINER. Contact EHS at 801-581-6590 immediately.
	+ Routinely test for the formation of peroxides using one of the approved methods.
	+ Dispose of ethyl ether, and other volatile peroxide forming compounds within 12 months. Complete hazardous waste tags for expired, degraded, or unwanted peroxide forming chemicals and take them to the next designated hazardous waste pick-up.

# Spill and Accident Procedure

* + Do not attempt cleanup if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operators. Call EHS office at 801-581-6590 for assistance.
	+ Isolate the area to prevent the spread of contamination (e.g. close doors to affected area, post warning signs, alert others in immediately vicinity to evacuate or not enter area). Ventilate area of leak or spill.
	+ Remove all sources of ignition.
	+ Absorb material with inert material, then place in suitable container. Do not use combustible materials, such as saw dust.
	+ Use water spray to dilute spill to a non-flammable mixture.
	+ Wear appropriate personal protection.
	+ Do not flush down the drain. Do not let this chemical enter the environment.
	+ Report all incidents to the EHS office at 801-581-6590

## \*\*Report all spills (minor and/or major) to the EHS office.

1. **Decontamination/Waste Disposal Procedure**

Drain disposal of chemicals is strictly prohibited. Empty containers of PFC’s can still pose a significant hazard. The containers should be triple rinsed and the first rinsate (first rinse liquid) collected for disposal as hazardous waste immediately after the last amount is removed. After triple rinsing, if the container is deemed to be free of residue, the label must be crossed out or defaced and the container can be discarded into the regular trash. Recycle glass only.

**NOTE:** Peroxide Forming Chemicals (PFCs) such as Ethers/tetrahydrofuran should be disposed of within one year from the date of opening / within the expiration date which is usually one year. PFC’s which have crossed the expiration date form shock sensitive crystals and might act as an explosive. Dispose of all the expired PFC’s by taking them to the next

scheduled EH&S waste pick-up with a recharge of $100 per expired Peroxide Forming Container. *Never guess the opening date on PFC containers.*

**NOTE:** If the PFC containers are too old (say more than 2 years from the date of opening or expiration date), do not handle such containers by yourself. Call 1-6590 for pick-up from the lab.

# Spill and Accident Procedure

**Spill** – Assess the extent of danger. Help contaminated or injured persons. 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.).

## All Dry/Powdered Spill Cleanup Materials:

Use the appropriate dry absorbent/ neutralizer such as the Universal Absorbent (General/solvent/oil/etc. spills), Dry Acid Neutralizer (Acid spills), Dry Base Neutralizer (Base spills), or Dry Hydrofluoric Acid Neutralizer (HF spills).

Sprinkle the absorbent material on the outer edges of the spill and continue sprinkling the powder inward to the middle of the spilled material until the absorbent/neutralizer has soaked up the spill and neutralized it. By beginning on the outer edges, the spill will be contained as you move inward. Sweep up the absorbent and place it in a garbage bag that is supplied in the kit.

## Spill Socks:

Spill Socks are used to prevent spills from spreading. They can absorb spill materials as well as be used as a barrier when a spill is threatening to flow into a drain or any other area.

## What To Do With The Waste (used absorbents, etc.:)

Once you have cleaned up the spill and placed the used absorbents in the bag, please go the EHS website at [www.ehs.utah.edu](http://www.oehs.utah.edu/) . Fill out a hazardous waste pickup request completely.

Someone from EHS will come pick up the waste and dispose of it properly. Please allow up to 10 working days for the waste to be picked up.

Waste pickup requests must be submitted via the EHS website.

If you have questions regarding your spill kit or the individual contents, please contact EHS at

801-581-6590.

If you need to order another spill kit or any of the restocking items, please contact EHS at

801-581-6590 and ask for your Research Safety Specialist.

**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 EHS at*

801-581-6590 *immediately.*

**Chemical Splash Into Eyes** – Immediately rinse eyeball and inner surface of eyelid with water for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EHS at* 801-581-6590 *immediately.*

## Medical Emergency Dial 911

**Life Threatening Emergency, After Hours, Weekends And Holidays** – Dial **911**

**Non-Life Threatening Emergency**– Go to the Redmed Clinic on the ground floor of the Union

building (801) 213-3303Hours: M - T, 8:00 a.m. to 5:00 F: 9:00 am – 3:30 p.m. *Note: All serious injuries must be reported to EHS at 801-58*1-6590 *within 8 hours.*

**Needle stick/puncture exposure** (as applicable to chemical handling procedure)– Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure, flush the affected area for 15 minutes using an eyewash station. Seek medical attention at Redmed Clinic. *Note: All needle stick/puncture exposures must be reported to EHS at 801-581-6590 within 8 hours.*

# Decontamination/Waste Disposal Procedure

Waste disposal procedures

General hazardous waste disposing guidelines:

Labeling Requirements for Hazardous Waste Containers:

* Fill out a hazardous waste pickup request completely via the SAM (Safety Administration Management) System or EHS website
* Someone from EHS will come pick up the waste and dispose of it properly. Please allow up to 10 working days for the waste to be picked up.

Waste pickup requests must be submitted via the EHS website.

Hazardous Waste Storage:

* Hazardous waste must be transferred to EHS for disposal within 90 days of being generated.
* Waste containers must be in secondary containment at all times to adequately contain the contents of the container/spilled materials.
* Hazardous waste must always be appropriately labeled with a University of Utah waste tag at all times.
* Containers must be closed when not in use.
* Storage of hazardous waste in fume hoods or under sinks is not recommended.
* Hazardous waste that meets the quantity threshold of 55 gallons of hazardous waste or 1 quart of extremely hazardous waste1 must be transferred to EHS for disposal within 3 days of reaching these set volumes.
* Report damaged containers to EHS. EHS can provide assistance to transfer the contents to an appropriate container.
* Mark storage areas according to the type of chemicals kept there (e.g. “Corrosive”, “Flammable”, etc.).
* Containers should be inspected weekly for signs of leaks, corrosion, or deterioration.

Hazardous Waste Disposal:

* Don't dispose of chemicals down the drain!
* Don't dispose of chemicals via trashcans.
* Don't use hoods to intentionally evaporate chemicals.
* Transport the hazardous waste to your designated pick-up location using a sturdy cart and secondary containment.
* Consult the hazardous waste pick-up schedule1 for the building specific times and locations of disposal.

# Safety Data Sheet (SDS) Location

*(State the location of SDS)*

Hardcopy or electronic copy must be available.

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# Protocol/Procedure

*(Add specific description of procedure.)*

**Note:** Any deviation from this SOP requires written approval from PI. **Documentation of Training** *(signature of all users is required)* I have read and understand the content of this SOP:

# Name Signature Date