



Date: 3/11/11
SOP Number: 0070

Effective: 3/11/11
Review Date: 3/11/13

Developed By: University Department of Environmental Health and Safety

Standard Operating Procedures For Peroxide-Forming Chemicals

Scope

This operating procedure pertains to peroxide-forming chemicals for all Drexel facilities. Peroxide forming compounds represent a class of materials which can become more dangerous with prolonged storage because they tend to form explosive peroxides with age. Exposure to light and air enhance the formation of the peroxides. A partially empty container increases the amount of air available, and hence the rate at which peroxides will form in the container. These compounds tend to absorb and react with oxygen from the air to form unstable peroxides which may detonate with extreme violence when they become concentrated by evaporation or distillation, when combined with other compounds that give a detonable mixture, or when disturbed by unusual heat, shock, or friction.

Applicability

This standard operating procedure applies to all operations of Department of Environmental Health and Safety (EHS) personnel and all research personnel on the University City (3141 Chestnut Street), Center City (245 North 15th Street), Doylestown (3805 Old Easton Road) and Queen Lane (2900 Queen Lane) campuses.

Purpose

The purpose of this document is to establish specific standard operating procedures for handling, storage, documentation and disposal of peroxide-forming chemicals. This procedure was developed in an effort to assist the Department of Environmental Health and Safety and the research population in tracking, handling and disposing of peroxide-forming chemicals in a safe and controlled manner.

Procedure

Laboratory Management Procedures

1. All peroxide-forming chemicals must have the receive date written on the label and the open date on the label.
2. Several peroxide-forming chemicals have expiration dates on them. Please observe this date.



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3. Two (2) months prior to the expiration date or the disposal deadline, as indicated above, the lab must arrange for a chemical pick-up by the Department of Environmental Health and Safety to dispose of the chemicals.
4. All peroxide-forming chemicals must be properly stored within the lab. As many peroxide-forming chemicals are also flammable, this may mean being properly stored within a flammable storage cabinet.
5. Lab personnel must periodically check there peroxide-forming chemicals. If any crystal formation or precipitation is noticed within the bottle or around the cap, the lab personnel must inform the Department of Environmental Health and Safety Immediately. Do not move or touch the container.
6. Peroxide-forming chemicals must not be evaporated, distilled, or heated without the approval from the Department of Environmental Health and Safety.

Procedures for the additions and deletions of the Peroxide-Disposal List

The Department of Environmental Health and Safety keeps an active list of known peroxide-forming chemicals on campus. This is to assist in tracking and disposal of peroxide-forming chemicals prior to expiration.

1. Additions are made when:
 - EHS Personnel observe peroxide-forming chemicals in the lab that:
 - Were not previously on the list
 - Do not have receive and/or open dates on them
 - Have expired
 - EHS Personnel have reviewed recent purchase orders. New purchase orders are added to the list.
2. The Hazardous Materials Manager and Chemical Safety Specialist will be notified of any new additions to the peroxide disposal list.

Deletions to the Peroxide Disposal list are made when expired or undated peroxide-forming chemicals are removed from the lab and disposed or deactivated.

Procedures for the schedule for List Auditing

1. The Peroxide Disposal List will be reviewed by EHS personnel:
 - The first Monday of every month



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- Whenever a new peroxide-former is added to the list.

Procedures when peroxide-formers are identified without date or label

1. Anytime a peroxide-former is identified without the receive/open dates or a label, the chemical will be added to the disposal list. The Hazardous Materials Manager and Chemical Safety Specialist will be notified of these peroxide-formers to arrange for their immediate removal and disposal.

Peroxide Testing Exceptions for the Principal Investigator

1. The Department of Environmental Health and Safety will allow principal investigators to store peroxide forming chemicals past their expiration date provided the material is tested for peroxides every six months. Principal investigators must receive written approval from the Department of Environmental Health and Safety before they may keep and test peroxide forming materials.
2. A log must be kept of the test results. The log shall contain the principal investigators name, date of test, result of test, and name of person conducting the test. The expiration date on the container label must be kept current. If the log is not maintained or expiration date not updated, the Department of Environmental Health and Safety will confiscate the material and charge back the cost of deactivating the material to the Department responsible.

Procedures for handling old peroxide-formers

1. Any peroxide forming chemical where the material may be inspected through the container will be inspected for the presence of peroxide crystals. If no crystals are present, the material will be transported to the temporary storage facility at Stratton Hall. If crystals are present, the material will be stored in the lab separate from other chemicals until a deactivation is scheduled.
2. Any peroxide forming chemical where the material may not be viewed nor has crystal formation at the bottle cap will be stored in the lab separate from other chemicals until a deactivation is scheduled.

Deactivation Procedures for Peroxide-Formers

1. Deactivations will be scheduled on an as needed basis. A licensed and insured company experienced in the deactivation of peroxide forming chemicals will be utilized. All deactivations will be scheduled at night starting at 11p.m. Deactivations



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taking place at New College Building will be conducted in the loading dock area of the building. Deactivations at the Main Campus will be conducted in the area between Main and Stratton Building. Deactivations at the Queen Lane campus will be conducted at the loading area behind the animal facility.

2. Prior to the deactivation date, Environmental Health and Safety will notify Public Safety at the appropriate campus and the City of Philadelphia Hazmat Unit via email of the date and time of the deactivation.
3. Prior to the start of the deactivation, Environmental Health and Safety will notify Public Safety at the appropriate campus that the deactivation is beginning. Requests for officer assistance may be made at that time if necessary.
4. At the completion of the deactivation, Environmental Health and Safety will notify Public Safety at the appropriate campus that the area is clear.
5. All materials neutralized will be labeled, dated and transported to the temporary storage area for inclusion in the quarterly chemical waste pickup.

Appendix

List of Common Peroxide-Forming Chemicals

1. Chemicals that may autopolymerize as a result of peroxide accumulation. Uninhibited chemicals must be disposed of within 24 hours of being opened. The Department of Environmental Health & Safety must be notified by the lab personnel before their purchase and use. Inhibited chemicals must be disposed of within 12 months of being opened:

Acrylic acid ^b	Tetrafluoroethylene ^c
Acrylonitrile ^b	Vinyl acetate
Butadiene ^c	Vinyl acetylene
Chloroprene ^c	Vinyl chloride
Chlorotrifluoroethylene	Vinyl pyridine
Methyl Methacrylate ^b	Vinyladiene chloride
Styrene	

2. Chemicals that form explosive levels of peroxides without concentration by evaporation or distillation. Some of these may form explosive concentrations of peroxide



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even if never opened. These chemicals must be disposed of within 3 months of being opened:

Butadiene ^a	Isopropyl ether
Chloroprene ^a	Tetrafluoroethylene ^a
Divinylacetylene	Vinylidene chloride

3. Chemicals that form explosive levels of peroxides on concentration by evaporation or distillation or otherwise treated to concentrate the peroxides. These peroxide formers that must be disposed of within 12 months of being opened:

(2-Ethoxyethyl)-o-benzoyl benzoate	Buten-3-yne
> 80% Hydrogen Peroxide	Chloroacetaldehydediethyl acetal
§-Bromophenetole	Chloromethyl methyl ether ^e
§-Chlorophenetole	Chloromethylene
1 -Pentene	Cumene
1-(2-Chloroethoxy)-2-phenoxyethane	Cyclohexanol
1-(2-Ethoxyethoxyethyl)ethyl acetate	Cyclohexene
1, 1-Dimethoxymethane	Cyclooctane
1, 2-Bis(2-chloroethoxy) ethane	Cyclopropyl methyl ether
1, 2-Dibenzoyloxyethane	Decahydronaphthalene
1, 2-Dichloroethyl ethyl ether	Di(1-propynyl) ether ^f
1, 2-Diethoxyethane	Di(2-propynyl) ether
1, 2-Epoxy-3-isopropoxypropane	Diacetylene
1, 2-Epoxy-3-phenoxypropane	Diallyl ether
1, 3-Dioxepne	Dicyclopentadiene
1, 5-p-Methadiene	Diethoxymethane
1,3 Butadiyne	Diethyl acetal isoamyl benzyl ether
1,3,3-Trimethoxypropene	Diethyl ether
1-Ethoxynaphthalene	Diethyl ethoxymethylene malonate
1-Ethoxy-2-propyne	Diethyl fumarated
1-Phenylethanol	Diethylene glycoldimethyl ether
2, 2-Diethoxypropane	Diethylketene ^f
2, 4-Dichlorophenetole	Dimethoxymethane



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2, 4-Dinitrophenetole	Dimethylketene ^f
2, 5 Hexadiyn-1-ol	Di-n-propoxymethane
2-Bromomethyl ethyl ether	Dioxanes
2-Butane	Ethoxyacetophenone
2-Chlorobutadiene	Ethyl §-ethoxypropionate
2-Cyclohexen-1-ol	Ethyl Vinyl Ether
2-Ethoxyethyl acetate	Ethylene glycol dimethyl ether (glyme)
2-Ethylacrylaldehyde oxime	Furan p-Phenylphenetone
2-Ethylbutanol	Isoamyl benzyl ether
2-Ethylhexanal	Isoamyl ether
2-Hexanol	Isobutyl vinyl ether
2-Methoxy ethanol	Isopropy 1,2,4,5 trichlorophenoxyacetate
2-Methoxyethyl vinyl ether	1,1,2,3,-Tetrachloro-1,3-butadiene
2-Methyltetrahydrofuran	Limonene
2-Penten-1-ol	Isophorone
2-Phenylethanol	m, o, p-Diethoxybenzene
2-Propanol	Methoxy-1,3,5,7-cyclooctateraene
3 -Ethoxy-o-propionitrile	Methyl isobutyl ketone
3, 3-Dimethoxypropene	Methyl p-(n-amyloxy) benzoate
3-Bromopropyl phenyl ether	Methyl-1-butanol
3-Isopropoxypropiontrile d	Methylacetylene
3-Methoxy ethyl acetate	Methylcyclopentane
3-Methoxy-1-butyl acetate	m-Nitrophenetole 1-Octene
4 Heptanol	n-Amyl ether
4, 5-Hexadien-2-yn-1-ol	n-Butyl phenyl ether
4-Methyl-2-pentanol	n-Butyl vinyl ether
4-Methyl-2-pentanone	n-Hexyl ether
4-Penten-1-ol	n-Methylphenetole
4-Vinyl Cyclohexene	n-Propylisopropyl ether
Acetal	o,p,-Ethoxyphenyl isocyanate
Acetaldehyde	o,p-Iodophenetole
Acrolein	o-Bromophenetole
Allyl ether	o-Chlorophenetole
Allyl ethyl ether	Other Secondary Alcohols
Allyl phenyl ether	Oxy bis (2 ethyl acetate)



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a-Phenoxypropionitrile chloride	Oxy bis (2-ethyl benzoate)
B,B Oxdipropionitrile	p-(n-Amyloxy)benzoyl chloride
Benzyl 1-naphthyl ether	p-Bromophenetole
Benzyl alcohol	p-Chlorophenetole
Benzyl ether	p-Dibenzoyloxybenzene
Benzyl ethyl ether	p-Di-n-butoxybenzene
Benzyl methyl ether	Perchloric Acid
Benzyl n-butyl ether	Phenoxy acetyl chloride
Bis(2-chloroethyl) ether	Phenyl o-propyl ether
Bis(2-ethoxyethyl) ether	p-Phenylphenetone
Bis(2-ethoxyethyl) phthalate	Sodium 8, 11, 14 elcosate traenoate
Bis(2-methoxyethyl) adipate	Sodium ethoxyacetylde
Bis(2-methoxyethyl) carbonate	tert-Butyl ethyl ether
Bis(2-methoxyethyl) ether	tert-Butyl methyl ether
Bis(2-methoxyethyl) phthalate	Tetrahydrofuran (THF)
Bis(2-methoxymethyl) adipate	Tetrahydronaphthalene
Bis(2-n-butoxyethyl) phthalate	Tetrahydropyran
Bis(2-phenoxyethyl) ether	Triethylene glycol diacetate
Bis(4-chlorobutyl) ether	Trithylene glycol dipropionate
Bis(chloromethyl) ether ^c	Vinyl ethers
Bis[2-(methoxyethoxy)ethyl] ether	Vinylene carbonate
B-methoxypropionitrile	Vinylidene chloride

4. Key:

- a When stored as a liquid monomer.
- b Although these chemicals form peroxides, no explosion involving these monomers have been reported.
- c When stored in liquid form, these chemicals form explosive levels of peroxides without concentration. They may also be stored as a gas in gas cylinders. When stored as a gas, these chemicals may autopolymerize as a result of peroxide accumulation.
- e OSHA regulated carcinogen.
- f Extremely reactive and unstable compounds.



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