DS Fact Sheet on **Managing Peroxide Formers in the Lab**

National Institutes of Health (NIH) • Office of Research Services (ORS) • Division of Safety (DS)

What are Peroxide Formers?

Peroxide forming chemicals are a group of chemicals that can, under certain conditions, form explosive peroxides which can be detonated by shock, friction, or heat. Typical molecular structure of the chemical for peroxide forming functional groups and the chemical families of peroxide formers are listed below:

Organic

- Aldehydes
- Ethers, acetals
- Dienes, vinyl acetylenes
- Ureas, amides, lactams
- Olefins with allylic hydrogens chloro- and fluoro-olefins & terpenes

Inorganic

- Alkali metals, particularly potassium
- Alkali metal alkoxides and amides
- Organometallics

Tetrahydrofuran, dioxane, diethyl ether, 2-propanol, and isopropyl ether are the most used peroxide formers at NIH.

Table 1 - List of Commonly Found Peroxide Formers*

Class A: These chemicals can form explosive levels of peroxides during storage without concentration. Test open bottles for peroxide formation before using or discard after 3 months. Dispose of after 12 months even if unopened.

Isopropyl ether Butadiene Chlorobutadiene (Chloroprene)	Potassium amide Potassium metal	Sodium amide Tetrafluoroethylene	Divinyl acetylene Vinylidene chloride

Class B: Test every 6 months for peroxide formation following the date of opening. These chemicals are a peroxide hazard during storage and on concentration (distillation/evaporation). Dispose of after 12 months unless testing indicates no peroxides present. Test for peroxides immediately before evaporation or distillation.

Acetal Acetaldehyde Benzyl alcohol Benzaldehyde 2-butanol Cumene Cyclohexanol 2-Cychlohexen-1-ol Cyclohexene Cyclopentene Diacetylene	Dicyclopentadiene Diethylene glycol Dimethyl ether Diethyl ether Dioxane Ethylene glycol Furan Methyl acetylene Methyl cyclopentane Methyl-isobutyl ketone 2-pentanol 4-pentene-1-ol	1- phenyl ethanol 2- propanol *(test prior to concentration or distillation only) Tetrahydrofuran Tetrahydronaphthalene Vinyl ethers

Class C: Test every 6 months following the date of opening. Unsaturated monomers may autopolymerize because of peroxide accumulation. Open bottles without inhibitors must be discarded within 24 hours. Open bottles with inhibitors must be disposed of after 12 months unless testing indicates no peroxides present.

Acrylic acid Butadiene Chlorotrifluoroethylene	Ethyl acrylate Methyl Methacrylate Styrene	Vinyl acetate Vinyl chloride Vinyl pyridine

** The list in Table 1 is illustrative, not comprehensive. Check the SDS of your chemical to determine if it forms peroxides.*

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Managing Peroxide Formers in the Lab

Keep the inventory of peroxide formers to the minimum amount needed. When possible, obtain them with an inhibitor or stabilizer. Never distill peroxide forming chemicals to dryness. Always leave a minimum of 20% of the chemicals in the still.

Labeling

Label containers of peroxide forming chemicals with the date of receipt, the date of opening, and date of expiration using a DOHS approved label.
Periodic testing to detect peroxides should be performed and the date of testing/findings must be documented.

Storage

- Follow manufacturer's storage guidelines.
- Store in airtight bottles, away from light and heat. Avoid using glass ground stoppers.
- Store under inert gas, if possible. Although storage under inert gas or with a stabilizer may prolong shelf-life, test the container for peroxides before use or before any possible distillation procedure.

Inspection

Peroxide formers must be inspected before each use. Crystallization (around the cap or in solution), discoloration, and stratification (oily layer or second liquid phase) are signs of peroxide former may have become shock sensitive.
Do not move or touch the container. Call the Chemical Waste Services, your IC Safety Specialist and PI/supervisor.
Chemical Waste Services will determine if the fire department should be called. Contact numbers:
Bethesda: (301) 496-4710 • **Baltimore**: (667) 312-5762 • **Phoenix**: (602) 200-5308 • **Frederick**: (240) 236-9575 • **RML**: (406) 363-9212

Testing

Test open bottles of Class A for peroxide formation before every use. Test Class B and C every six months and prior to distillation or evaporation using the commercially available test strips (available from many chemical vendors). Commercial test strips have a test range of approximately 0.5 to 100 ppm. When testing for peroxide, use the guidelines in **Table 2** to interpret results and determine action to take. **High Hazard peroxide formers such as pyrophoric, water-reactive, acutely toxic chemicals, solid chemicals like potassium metal, potassium amide, and sodium amide should not be tested for peroxide formation. Only use visual signs for peroxide formation for those chemicals.**

Table 2

< 25 ppm	Considered safe for general use
25-100 ppm	Not recommended for distilling or concentrating
>100 ppm	Avoid handling and contact Chemical Waste Services for safe disposal immediately.

Disposal

Follow the above guidelines for the disposal of each Class. If you notice any discoloration or decomposition during routine inspection, dispose of immediately even if it is before the expiration date. Follow NIH Waste Disposal Guide for details.

References

- Sigma Aldrich – Peroxide Forming Solvents Information Page
  https://ehs.yale.edu/sites/default/files/files/peroxide-formation-sigma.pdf
- NRC Prudent Practices in the Laboratory: Organic Peroxides and Peroxidizable Compounds
  https://www.nap.edu/read/12654/chapter/7#133
- Clark, D.E., Peroxides and Peroxide - Forming Compounds, Chemical Health
- and Safety, 2001, 8 (5), 12-21.