

SAFETY OFFICE GUIDE FOR PEROXIDE FORMING CHEMICALS

Revised August 2025

Abstract

This document outlines safety protocols and regulatory guidance for the storage, handling, testing, and disposal of peroxide forming compounds at NDSU. The guidelines aim to prevent laboratory accidents and ensure compliance with safety standards.

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Introduction

Overview

Peroxide forming chemicals are among the most hazardous substances commonly handled in laboratories. Several common solvents (e.g., diethyl ether, tetrahydrofuran, dioxane) can form explosive peroxides through slow oxidation when exposed to air and light. Since most peroxide-forming chemicals are packaged with air, even unopened containers can develop dangerous levels of peroxides. Stabilizers and refrigeration may slow, but do not prevent, peroxide formation. Once formed, peroxides may detonate due to heat, shock, impact, or friction.

IMPORTANT: *If you observe crystals inside of the container or around the cap of a peroxide forming chemical, or precipitation or cloudiness in a peroxide forming chemical container, do not move the container and contact the Safety Office immediately.*

The NDSU Safety Office

The NDSU Safety Office plays a central role in the safe management of peroxide forming chemicals on campus. The Safety Office's responsibilities include:

- **Training and Outreach:** Providing guidance and training to laboratory personnel on the safe handling, storage, and disposal of peroxide forming chemicals.
- **Initial Response:** Responding to reports of suspected peroxide crystal formation or other signs of instability and coordinating efforts to secure the container.
- **Peroxide Testing Support:** Advising on proper testing protocols, including interpretation of results and appropriate follow-up actions.
- **Disposal Coordination:** Assisting laboratories with hazardous waste pickup requests for peroxide forming compounds, including those requiring contractor involvement.
- **Policy Development:** Maintaining university-wide guidelines and protocols for peroxide forming compound management and ensuring alignment with state and federal regulations.

For any concerns or suspected hazards related to peroxide formers, contact the NDSU Safety Office immediately. Safety is a shared responsibility, and timely communication is critical in preventing accidents and maintaining a safe research environment.

UPSO Contact Information

The University Police and Safety Office is available at 701-231-7759 or via email at ndsu.police.safety@ndsu.edu. More information is available on the [UPSO webpage](#).

Peroxide Forming Chemical Management

Proper management of peroxide forming compounds is critical to ensuring a safe research environment. Consistent and proactive management will significantly reduce the risk of accidental exposure or detonation.

The lab should maintain written SOPs for the use and management of peroxide forming chemicals to include periodic monitoring and testing.

Management Guidelines

Laboratory personnel should follow practices to minimize the risk of peroxide accumulation:

- **Maintain a detailed inventory** of all peroxide forming chemicals in your lab, including class, receipt date, opening date, and expiration date.
- **Label all containers clearly** with dates of receipt, opening, testing, and expiration. Include test results and initials of the person conducting the test.
- **Routinely inspect** all peroxide formers for signs of degradation, such as crystal formation, cloudiness, or precipitates. If any of these are present, do not move the container—contact the Safety Office immediately.
- **Test chemicals regularly** based on their classification (List I/II/III) and before performing high-risk procedures like distillation or evaporation.
- **Store chemicals properly** in tightly sealed amber bottles, away from light and heat sources. Do not store opened peroxide formers in refrigerators or freezers.
- **Minimize storage quantities.** Order only what is needed for immediate use to reduce the likelihood of long-term degradation.
- **Dispose of chemicals** promptly when they reach their expiration date or test above 100 ppm peroxides. Disposal must follow hazardous waste protocols coordinated with the Safety Office.
- **Avoid inhibitor-free versions** of peroxide forming chemicals unless absolutely necessary for the research application.

Evaluating and Testing for Peroxides

The NDSU Safety Office will not collect peroxide forming chemicals that have exceeded their retention time unless the peroxide concentration has been determined. Follow the steps below before requesting disposal:

Step 1: Visual Inspection

Examine the container for visible signs of peroxide formation. Crystals or a viscous residue on the inner surfaces, cap, or neck of the bottle indicate a serious hazard.

Do not touch or move containers with these signs—immediately contact the NDSU Safety Office at 701-231-7759.

Step 2: Determine if Testing is Safe

Do not test the chemical if less than 10% of the original volume remains, or if the container is visibly compromised. Otherwise, testing is allowed under these age criteria:

- **Medium hazard (List II/III below):** Opened <1 year, unopened <2 years
- **High hazard (List I below):** Opened <6 months, unopened <1 year

If any of these conditions are met, then testing is not safe. Stop immediately and contact the NDSU Safety Office before proceeding.

Step 3: Test for Peroxides:

Peroxide Test Strips:

Use commercial peroxide test strips (e.g., Sigma-Aldrich, JT Baker) for ethers (e.g., diethyl ether), THF, and p-dioxane. Follow manufacturer instructions carefully. Contact the NDSU Safety Office for assistance if needed.

If peroxide concentration is >10 ppm, stabilization is required before disposal. Please contact the Safety Office.

Step 4: Laboratory Stabilization or Destruction of Peroxides

To **stabilize** and prevent further formation of peroxides:

- Add 1 gram of butylated hydroxytoluene (BHT) per liter of chemical.
- This does not neutralize existing peroxides but helps prevent new formation.
- Clearly label the container with the stabilization date and measured peroxide level.

To **destroy** peroxides in solution:

- Always contact the Safety Office prior to peroxide destruction.
- Prepare ferrous ammonium sulfate (FAS) solution. Directions for preparing 500 ml of FAS solution are listed below:
 - In a suitable container, add 400 ml of deionized water.
 - Slowly add 30ml of concentrated H_2SO_4 to the water while stirring (never add water to acid).
 - Add 30g ferrous ammonium sulfate to the acidified water and stir until completely dissolved.
 - Add the remaining water to bring the total volume to 500 ml.
 - Allow the solution to cool for at least 15 minutes.
- Peroxide destruction:
 - Slowly add 20 mL of the FAS solution to the peroxide-containing solvent.
 - Gently mix for at least 10 minutes.
 - Recheck peroxide concentration using an appropriate test.
 - If the peroxide concentration is >0 ppm, repeat the addition and mixing steps until the target concentration (0ppm) is reached.

Step 5: Hazardous Materials Contractor Disposal

If crystals are visible or testing/stabilization/destruction is not safe or feasible, contact the Safety Office immediately. Secure and clearly label the area around the container to prevent disturbance. The Safety Office will coordinate disposal with a hazardous waste contractor.

Lists of Peroxide Forming Chemicals

List I <u>High Peroxide Hazard</u> DISCARD WITHIN 12 MONTHS OR TEST FOR PEROXIDES BEFORE USE Peroxide Formation on Storage	List II <u>Medium Peroxide Hazard</u> DISCARD WITHIN 18 MONTHS OR TEST FOR PEROXIDES BEFORE USE Peroxide Formation on Concentration	List III <u>Medium Peroxide Hazard</u> DISCARD WITHIN 18 MONTHS OR TEST FOR PEROXIDES BEFORE USE Hazard Due to Peroxide Initiation of Polymerization
Diethyl ether	Acetal	Styrene
Diacetylene	Cyclohexene	Acrylic acid
Dicyclopentadiene	Dioxane	Acrylonitrile
Divinyl acetylene	Furan	Butadiene
Divinyl ether	Methyl cyclopentane	Chlorobutadiene
Ethylene glycol dimethyl ether	Methyl isobutyl ketone	Chloroprene
Isopropyl ether	Tetrahydrofuran (THF)	Chlorotrifluoroethylene
Potassium amide	Vinyl acetate	Methyl methacrylate
Sodium amide (sodamide)	Vinyl acetylene	Tetrafluoroethylene
Vinylidene chloride	Vinyl chloride	Vinyl acetate
Vinylidene chloride	Vinyl ethers	Vinyl chloride
	Vinyl pyridine	Vinyl pyridine
		Vinylacetylene
		Vinyladiene chloride

These lists are not exhaustive. Always check the Safety Data Sheet (SDS) for the chemicals in your laboratory to determine if it may form peroxides. Contact the Safety Office with any questions or concerns.