

Syracuse University

Laboratory Guidance Document

Pyrophoric Materials



This Laboratory Guidance Document was created by Syracuse University Environmental Health & Safety Services (EHSS) to assist researchers in developing laboratory specific standard operating procedures for the safe handling and disposal of pyrophoric materials.

Potential Hazards:

The main hazard associated with pyrophoric materials is fire upon contact with air or moisture. The high level of reactivity associated with these materials requires them to be handled in inert atmospheres free of ignition sources. Pyrophoric materials stored in highly flammable solvents (e.g., diethyl ether, hexane) further increases the risk and severity of fires. Many pyrophoric materials are also classified as acutely toxic, corrosive, reproductive toxins, or peroxide-forming.

Physical & Chemical Properties:

Pyrophoric liquids, solids, and gases are chemicals that may ignite or react violently when exposed to air at temperatures $<55^{\circ}\text{C}$ (130°F). Many pyrophoric chemicals are also water reactive and become spontaneously flammable or emit flammable gases in potentially dangerous quantities upon contact with water.

General Precautions:

The use of pyrophoric materials requires extreme care; if not stored, handled, and disposed of properly, these materials pose a serious threat to the health and safety of laboratory personnel, emergency responders, and waste handlers.

1. Training.

The Principal Investigator (PI) is responsible for ensuring all personnel under their supervision are made aware of hazards of pyrophoric materials, have received the appropriate hands-on training, adhere to the laboratory standard operating procedures, and are provided with the appropriate personal protective equipment (PPE).

2. Work under the buddy system.

Pyrophoric materials should never be handled while working alone. At least one additional person trained in the safe handling of pyrophoric materials should be present in the general vicinity of the work area while a pyrophoric material is used.

3. Handle only under an inert atmosphere.

Never expose a pyrophoric material to the atmosphere. Handle solid pyrophoric materials inside a glove box flooded with inert gas (e.g., nitrogen). Liquid pyrophoric materials may be handled inside a fume hood using the air-sensitive materials transfer techniques described in the Aldrich Technical Bulletins [AL-134](#) and [AL-164](#).

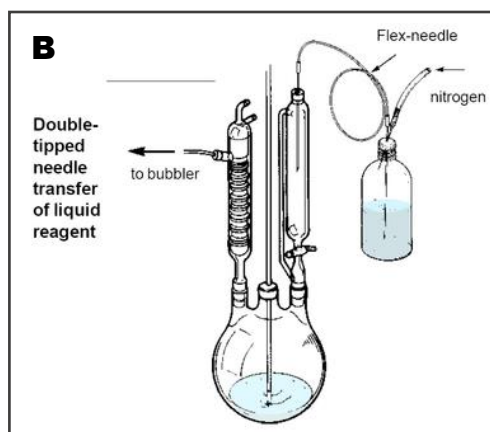
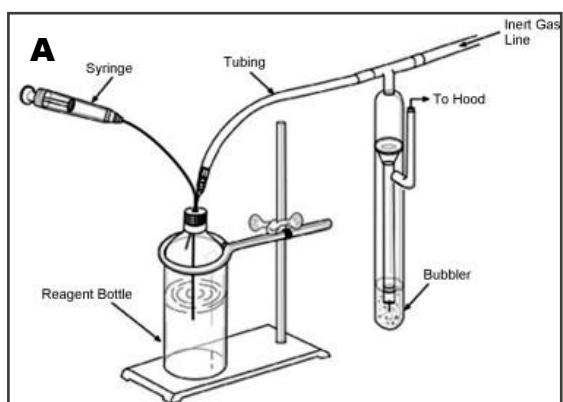
Personal Protective Equipment (PPE):

In addition to the standard laboratory attire (i.e., long pants and closed toe shoes), the following PPE is recommended for all protocols involving pyrophoric materials:

- ANSI certified (Z87) chemical splash goggles.
- Full face shield when handling pyrophoric materials inside a fume hood
- Knee-length flame resistant (FR) lab coat
- Chemically compatible gloves

Best Practices for the Safe Handling of Pyrophoric Chemicals:

1. Review the Safety Data Sheet (SDS), laboratory standard operating procedure (SOP), and emergency procedures before starting any work requiring pyrophoric materials.
2. Post a hazard warning sign (*Appendix I*) and emergency response procedure in all storage and use areas.
3. Design a quenching scheme for residual materials. Never use water to quench the material itself or a reaction where a pyrophoric material is used.
4. Oven-dry all glassware and transfer devices to eliminate moisture.
5. Keep a beaker of dry sand within arm's length to extinguish any small fires that occurs at the needle tip.
6. Purge all glassware and syringes/cannula multiple times with inert gas.
7. When transferring pyrophoric liquids inside a fume hood, ensure that the entire transfer system is airtight and under slight positive pressure of inert gas.
8. Perform a trial run of the experiment using water to ensure suitable apparatus set up and transfer techniques. Inspect all glassware and transfer devices for leaks.
9. Work away from water sources or areas where there is the potential for a water splash.
10. Secure containers to avoid tip overs and spills. Clamp the container and receiving vessel in order to leave both hands free.
11. Use only thin gauge (<16G) and flexible needles. Needles should be of adequate length to easily reach to the bottom of chemical bottles and allow for a greater range of movement inside the glovebox/fume hood.
12. Use a needle and syringe to transfer small volumes (<10mL). Select a syringe that will hold twice the volume that is to be transferred (i.e., use a 20mL syringe to transfer 10mL). To ensure a leak-free connection, use only Luer-locking devices.
13. Use a cannula (double-tipped needle) to transfer large volumes (>10mL).
14. Never return excess chemical to the original container.



Pyrophoric liquid transfer techniques: (A) Syringe transfer assembly equipped with an inert gas line and oil bubbler. (B) Cannula transfer assembly equipped with an inert gas line and oil bubbler.

Source: [AL-164 Handling Pyrophoric Reagents](#)

Storage Considerations:

Whenever possible, store all forms of pyrophoric materials in an inert gas-filled desiccator or glove box. Never leave a pyrophoric material container on the bench top.

- Procure and store only the smallest practical quantities for the experiment performed.
- Store in a dry area away from ignition and combustion sources.
- Segregate from all other chemicals in the laboratory during use and storage.
- Some organolithiums must be stored in a flammable-materials refrigerator. Consult the chemical's SDS for proper storage conditions.
- If a pyrophoric material is received in a specially designed storage or dispensing container (e.g., Aldrich Sure/Seal) ensure that the integrity of that container is maintained and sufficient protective solvent, oil, or inert gas remains in the container.

Disposal & Waste Management:

Quenching is the process of neutralizing pyrophoric liquids with an agent that has a reactive hydroxyl group. Unused and/or unspent pyrophoric liquids must be quenched prior to disposal. Quenched pyrophoric materials should be disposed of as hazardous waste. Contact the EHSS Hazardous Waste Group at 315.443.9132 for removal.

- Quench pyrophoric materials under an inert atmosphere and in an ice bath.
- Dilute with a non-reactive solvent such as heptane or toluene. Avoid using low-boiling solvents such as ether or pentane that tend to condense water upon evaporation.
- Begin quenching by first adding a low-reactivity agent such as isopropanol, follow by a more reactive agent such as methanol.
- Confirm there are no pockets of unquenched pyrophoric liquid by adding water dropwise.

Empty pyrophoric liquid containers must also be prepared for disposal:

- The empty container should be rinsed three times with a non-reactive solvent such as heptane or toluene. The rinse solvent should be transferred in and out of the container under an inert atmosphere using the syringe or the cannula technique.
- Collect the rinse solvent and quench prior to disposal.
- After the empty container is triple-rinsed, the container cap can be removed and the empty container left in the back of the fume hood overnight.

Fire Extinguishers:

Water is never used to extinguish a pyrophoric material fire as it can enhance the combustion of some of these materials. Contact Syracuse University Fire and Life Safety Services at 315.443.5475 for assistance with selecting an appropriate extinguisher.

- Class ABC (dry chemical) extinguishers are recommended for pyrophoric liquids.
- Class D (dry powder) extinguishers are recommended for combustible solid metal fires, but not for organolithium reagents.

Spill Response & Clean Up:

In the event of a pyrophoric material spill, EHSS will oversee and direct the cleanup. Depending on the location and/or severity of the spill, EHSS may seek assistance from an outside emergency response services provider.

Additional Resources:

1. Sigma-Aldrich Technical Bulletins: [AL-134 Handling Air-Sensitive Reagents](#)
[AL-164 Handling Pyrophoric Reagents](#)
2. U.S. Department of Energy: [Handling Pyrophoric Reagents](#)
3. Fire Equipment Manufacturers' Association: [Types of Extinguishers](#)

Appendix I. Hazard Signage.

Post this warning sign at all storage and use areas.

