# GUIDELINE

# Working with Pyrophoric Materials

Pyrophoric materials are substances that ignite instantly upon exposure to oxygen. They can also be water-reactive, where heat and hydrogen (a flammable gas) are produced. Other common hazards include corrosivity, teratogenicity, and organic peroxide formation, along with damage to the liver, kidneys, and central nervous system. Examples include metal hydrides, finely divided metal powders, nonmetal hydride and alkyl compounds, white phosphorus, alloy of reactive materials and organometallic compounds, including alkyllithiums.

Handling of pyrophoric and/or water-reactive materials is a high hazard operation and must be controlled with adequate system design, direct supervision, and training. Do not use pyrophoric reagents without a complete understanding of the hazards and risks involved or without appropriate hands-on training. New users of these reagents must work only under the close supervision of the PI or designated experienced user. All procedures must be two-person tasks - personnel may not work alone. Work with these materials requires written standard operating procedures (SOPs) and documented training for each person required to handle these materials. Failure to follow proper handling and storage procedures can result in fire or explosion, leading to serious injuries, death, and/or significant damage to facilities.

### *Controlling the Hazards*

**Whenever possible, pyrophorics/water-reactive materials should be handled under inert atmospheres or in such a way that rigorously excludes air/moisture since they can ignite upon contact with air and/or water. They all tend to be toxic and many come dissolved in a flammable solvent. Other common hazards include corrosivity, teratogenicity, water reactivity, peroxide formation, along with damage to the liver, kidneys, and central nervous system. Always consult the SDS, manufacturer and OEHS before working with these materials.**

1. **Potential hazards and reactivity must be reviewed and appropriate safety measures implemented prior to starting any experiment. BEFORE working with pyrophoric/water-sensitive reagents, do the following:**
2. **Consult with PI for approval before work with these materials.**
3. **If possible, use safer chemical alternatives.**
4. **Limit the amount purchased and do not accumulate unneeded pyrophoric reagents**
5. **Read the relevant Safety Data Sheets (SDS), technical bulletins, and guidance documents to aid in the recognition and reduction of potential hazards.**
6. **Conduct a hazard assessment and identify potential failure or weak points in your experimental design. Be prepared to handle accidents. Consult with OEHS for assistance.**
7. **Conduct all work in a fume hood or glove box.**
8. **Prepare a written Standard Operating Procedure (SOP) identifying the safety precautions specific to the operations. Train personnel on the componenets of the SOP. Document all training in writing.**

- **Perform a "dry run" of the SOP to identify and resolve possible problems before conducting the actual procedure.**
- **Identify best method of transfer based on volume of material used (syringe vs. cannula)**
- **Ensure training in proper technique is complete and personnel demonstrate proficiency.**
- **Search for alternative materials/techniques to minimize risk and the amount of hazardous waste generated.**

9. **Know the location of eyewash/shower, fire extinguishers, fire alarm pulls, and emergency exits.**
10. **Never work alone or during off hours when there are few people around to help in an emergency.**
11. **Wear the appropriate personal protective equipment. This includes fire resistant labcoat, goggles/face shield and gloves.**
12. **Keep workspace clean and clear of any combustible materials, including paper towels, wood, and plastics.**
13. **Perform syringe transfers with a Luer lock syringe**
14. **Use the smallest quantity of material practical. It is better to do multiple transfers of small volumes rather than attempting to handle larger quantities. However, when transferring volumes that are >50mL or that exceed 50% of the syringe, an alternate method should be employed (e.g. use a larger syringe or perform a cannula transfer). If cannula transfers are necessary to perform, be extremely cautious not to overpressurize the container. A standard pressure range for a transfer with inert gas on a vented apparatus is between 3 and5 psi.**

**15. In order to reduce the possibility of clogging during transfer of materials, use a larger bore needle, such as a 16-18 gauge needle. Remove all excess and nonessential chemicals and equipment from the fume hood or glove box where pyrophoric chemicals will be used to minimize the risk of fire.**

**15. NEVER return excess chemical to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion.**

**15. All recurring minor procedural incidents, including small flash fires, must be evaluated and managed in order to avoid any potential for major incidents. All corrective actions should be discussed with PI (in some cases, OEHS) and documented.**

## *Disposal Considerations*

1. All unwanted materials that contain, or potentially contain, pyrophoric or water-reactive materials must be disposed of as hazardous waste. Submit an Unwanted Materials Pick-up Request through the online Lab Management System on the OEHS website oehs.utah.edu
2. Labeling must be descriptive and include the chemical name and potential hazard associated with handling. Label teh container with the date the container was opened.
3. NEVER open a container with residual pyrophoric material in the atmosphere.
4. Should a pyrophoric chemical solution dry out, immediately take necessary steps to re-dissolve the solid with an appropriate solvent. Where possible, use the same solvent that the manufacturer used. Contact OEHS for assistance if needed.
5. Ensure that all reactive chemicals have been sufficiently consumed during the experiment. If reactives are suspected to remain, please take the following pre-cautions as the last step of your experiment:

- Under an inert atmosphere, rinse the empty container three times with a dry, COMPATIBLE solvent; the rinsate must also be neutralized or hydrolyzed, and removed from the container under inert atmosphere.
- The empty, rinsed container can be placed in the broken glass container after sufficient drying time in the hood. The solvent rinse should be collected and disposed as hazardous waste. Do not mix with other incompatible waste streams.
- All consumable materials that are contaminated with pyrophoric chemicals must be quenched and disposed of as hazardous waste. Please contact OEHS for assistance before quenching if needed
- Alert OEHS of any wastes contaminated by pyrophoric/ water-reactive chemicals by adding in comments during the electronic submission process and by using appropriate container labeling practices.
- All waste-related material should be stored appropriately (e.g. kept in the fume hood or flammables cabinet) until it is removed by OEHS.

## *Storage Considerations*

1. Pyrophoric chemicals must be stored under an atmosphere of inert gas or under solvent as appropriate. Avoid heat, flames, oxidizers, and water sources. Containers must be clearly labeled with the correct chemical name and hazard warning. Do NOT allow pyrophoric chemicals stored in solvent to dry out. Check periodically to ensure there is a visible amount of solvent in the bottle. It is possible for sufficient solvent to evaporate that highly active pyrophoric material crystallizes from solution (e.g. lithium aluminum hydride in THF). If this occurs contact OEHS for assistance.
2. Store pyrophoric chemicals in a rated flammables storage cabinet away from other flammable materials, in a rated flammable storage refrigerator/freezer, in a glove box, or a nitrogen filled dessicator. Consult the SDS for the most appropriate storage location.
3. If pyrophoric reagents are received in specially designed shipping, storage or dispensing containers, (such as the Aldrich Sure/Seal packaging system) ensure that the integrity of that container is maintained.
4. DO NOT return excess chemical to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion.
5. For storage of excess chemical, prepare a storage vessel in the following manner:

- Select a septum that fits snugly into the neck of the vessel
- Dry any new empty containers thoroughly
- Insert septum into neck in a way that prevents atmosphere from entering the clean, dry (or reagent-filled) flask.
- Insert a needle to vent the flask and quickly inject inert gas through a second needle to maintain a blanket of dry inert gas above the reactive reagent.
- Once the vessel is fully purged with inert gas, remove the vent needle, then the gas line.
- For long-term storage, the septum should be secured with a copper wire (Figure 1).
- For extra protection a second same-sized septa can be placed over the first (Figure 2).
- The additional use of parafilm around the neck and top of the container may help to maintain the integrity of materials during storage.

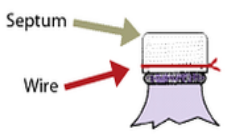

**Fig. 1A** Septum wired to vessel

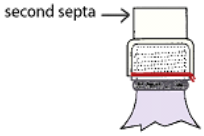

**Fig. 1B** For long-term storage, use a second septum

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