

PYROPHORIC CHEMICALS

(For assistance, please contact EHS at (402) 472-4925, or visit our web site at <http://ehs.unl.edu/>)

The term “pyrophoric” describes chemicals that will ignite spontaneously in air at temperatures of 130° F (54° C) or below. Pyrophoric chemicals react with oxygen, moisture in the air, or both. Failure to follow proper handling techniques can result in spontaneous combustion or explosion, leading to serious burns and other injuries.

EXAMPLES OF PYROPHORIC COMPOUNDS

- | | |
|---|---|
| <ul style="list-style-type: none"> • <i>Grignard reagents:</i> RMgX • <i>Metal alkyls and aryls:</i> RLi, RNa, R₃Al, R₂Zn • <i>Metal carbonyls:</i> Ni(CO)₄ (Nickel tetracarbonyl), Fe(CO)₅ (Iron pentacarbonyl), Co₂(CO)₈ (Dicobalt octacarbonyl) • <i>Metal powders:</i> Al (Aluminum), Co (Cobalt), Fe (Iron), Mg (Magnesium), Mn (Manganese), Pd (Palladium), Pt (Platinum), Ti (Titanium), Sn (Tin), Zn (Zinc), Zr (Zirconium) | <ul style="list-style-type: none"> • <i>Metal hydrides:</i> NaH (Sodium hydride), LiAlH₄ (Lithium tetrahydridoaluminate) • <i>Nonmetal hydrides:</i> B₂H₆ (diborane) and other boranes, PH₃ (Phosphine), AsH₃ (Arsine) • <i>Nonmetal alkyls:</i> R₃B, R₃P, R₃As (materials containing boron, phosphorous, or arsenic) • <i>Phosphorus</i> (white) • <i>Gases:</i> Silane, Disilane, Dichlorosilane, Diborane, Borane, or Phosphine |
|---|---|

*R= organic group; X=halogen

Observe the following general safe-handling techniques when handling pyrophoric chemicals, as well as specific instructions provided during training and by the applicable Safety Data Sheet (SDS) and manufacturer’s technical bulletin(s). Special considerations for pyrophoric gasses are discussed in the EHS SOP, **Compressed Gas Cylinders in Laboratories**.

- Verify accessibility and operability of safety shower and eyewash in the immediate work area.
- Receive prior instruction from your supervisor regarding procedural hazards and control measures. Practice your technique with a non-hazardous material before handling a pyrophoric chemical and have your technique evaluated by an experience person.
- Remove all excess and nonessential chemicals and equipment from the area where pyrophoric chemicals are in use. This will minimize the number and quantity of other chemicals and materials at risk should a fire occur. Combustible materials, including paper products, should not be allowed to come in contact with any pyrophoric reagent at any time.
- Use and store minimal amounts of pyrophoric chemicals. Do not store pyrophoric chemicals with flammable materials or in a flammable-liquids storage cabinet. Store as recommended

in the Safety Data Sheet, for example, in a dry, inert atmosphere such as a nitrogen-filled desiccator or glove box.

- If packaged in a specially designed shipping/storage/dispensing container, ensure that the integrity of the container is maintained. Some reactive metals are packaged, shipped, and stored under oil or kerosene. Ensure that sufficient protective solvent remains in the container while the material is stored.
- Conduct operations in a manner to prevent exposure to the atmosphere. Several techniques, depending on the physical state and quantity used, are available. These techniques range from use of gas-tight syringes to glove boxes. If using a gas tight syringe technique, use a syringe with ample extra volume beyond the amount to be measured so that the syringe plunger is not withdrawn to near the end of the syringe barrel.
- Use pyrophorics in a fume hood to provide a measure of containment of both vapors and flames from an adverse event. Glove boxes may be used if inert or dry atmospheres are required.
- Never return excess chemicals to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion.
- Class D fire extinguishers, soda ash, or dry sand can be used to smother and extinguish small fires.
- DO NOT use carbon dioxide or water fire extinguishers as these types of extinguishers can actually enhance the combustion of some pyrophoric compounds.
- As with all laboratory operations, appropriate personal protective equipment is a must when handling hazardous chemicals.
 - Flame retardant lab coat or other protective outer garment, along with natural fiber long pants and close-toed shoes. For additional guidance, see EHS SOP, **Personal Protective Equipment – Body Protection**.
 - At a minimum, eye protection in the form of safety glasses with side shields. If there is a splash hazard, upgrade eye protection to goggles or goggles and face shields.
 - Protective gloves. Advice on chemical resistant glove selection is available in the applicable SDS. Glove guides and other chemical safety information may be accessed through the EHS web site, under the **Documents>Chemical Safety** tab. For additional guidance, see EHS SOP, **Personal Protective Equipment –Hand Protection**.
 - Other protective apparel as appropriate to the hazard. See EHS SOP, **Personal Protective Equipment for Chemical Exposures**. PPE training is available on the EHS web site (Web Based Training tab).
- Contact EHS for guidance on safe disposal of pyrophoric chemicals.
- For additional general information, see Aldrich Technical Bulletin AL-134, [Handling Air-Sensitive Reagents](#) and; Aldrich Technical Bulletin AL-164, [Handling Pyrophoric Reagents](#).
- See instructional video produced by the University of California San Diego titled [Working with Pyrophoric Reagents](#) for additional guidance.

- See the following EHS Colloquium presentations, available on the EHS web page (Training>Laboratory Safety Colloquium Series):
 - Pyrophorics (Air Sensitive) Chemical Safety
 - Safe Handling: Unstable, Reactive, & Energetic Chemicals