

## Common Standard Operating Procedure

for work with

Chemical name/class:	Pyrophoric and other highly reactive materials	CAS #:	Various
PI:	Kenneth Henderson	Date:	1/23/2013
Building:	Stepan	Room #:	385
Designated Work Area:		Laboratory Stepan 386	

### 1. Circumstances of Use:

Pyrophoric materials are commonly used in the Henderson lab as reagents, intermediates and the subject of study. They can only be used after appropriate training by an experienced coworker. Their use is limited to working in an approved area (e.g. fume hood, glove box, freezer, etc.). Proper disposal and clean-up procedures must be understood before using any pyrophoric materials.

### 2. Potential Hazards:

Pyrophorics are chemicals that, even in small quantities, are liable to ignite within five minutes after coming into contact with air.

*Check the Safety Data Sheet (SDS) to see if the material presents other hazards, such as corrosivity, teratogenicity, water reactivity, peroxide formation, or systemic effects. If other hazards are present, appropriate safety precautions should be addressed in this SOP.*

Some classes of pyrophoric materials are listed below:

#### *Some Classes of Pyrophoric Chemicals*

#### *Examples of class*

Grignard reagents	RMgX
Metal alkyls and aryls	RLi ( <i>tert</i> -butyl lithium is very pyrophoric), RNa, R <sub>3</sub> Al, R <sub>2</sub> Zn
Metal carbonyls	Ni(CO) <sub>4</sub> , Fe(CO) <sub>5</sub> , Co <sub>2</sub> (CO) <sub>8</sub>
Alkali metals	Na, K, Rb, Cs
Metal powders	Al, Ca, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr, Sr, Ba
Metal hydrides	NaH, LiAlH <sub>4</sub>
Nonmetal hydrides	B <sub>2</sub> H <sub>6</sub> and other boranes, PH <sub>3</sub> , AsH <sub>3</sub> , SiH <sub>4</sub>
Nonmetal alkyls	R <sub>3</sub> B, R <sub>3</sub> P, R <sub>3</sub> As
Phosphorus (white)	

### 3. Engineering Controls:

- Liquid pyrophorics should be stored in sealed containers with PTFE-lined septa or in appropriate Schlenk apparatus to prevent air exposure. They should be manipulated in a glove box or via syringe or cannula in a chemical fume hood (over a spill tray if possible) with the sash as low as possible.
- Solid pyrophorics must be handled only in an inert atmosphere glove box or using appropriate Schlenk apparatus in a chemical fume hood.

- Care should be taken to release pressure from reagent or reaction vessels. This can be done using a Schlenk line with a mineral oil bubbler.
- Manipulation of some pyrophorics may require the use of a blast shield.
- Minimize exposure to other chemicals, especially flammables, when manipulating pyrophoric materials.

#### 4. **Work Practice Controls:**

Before working with these compounds, read the SDS and other reference material carefully. Good web resources include:

- [UCSD training videos](#)
- [Lab Safety Workplace – Handling Pyrophoric Materials training course](#)
- Sigma Aldrich Technical Bulletins [AL-164](#) (Handling Pyrophoric Reagents) and [AL-134](#) (Handling Air-Sensitive Reagents). Other [Aldrich Technical Bulletins](#) describe specific laboratory equipment designed for use with air- and moisture-sensitive reagents.)
- *Prudent Practices in the Laboratory* (National Academies Press) Sections [4.D](#) and [6.G](#) and Laboratory Chemical Safety Summaries for
  - [Butyllithiums](#)
  - [Sodium \(reactive metal\)](#)
  - [Lithium aluminum hydride](#)
- Ensure a compatible fire extinguisher is on hand before any work with the pyrophoric material takes place (and preferably before the material is ordered).
- Purchase minimal amounts of pyrophoric materials.
- Only use pyrophoric materials in a chemical fume hood and/or a glove box. Ensure access within 10 seconds of an eyewash/drench hose, safety shower, and an appropriate fire extinguisher.
- Incompatible materials should be removed from the area.
- A container of powdered lime or sand should be kept within arm's reach (for covering spills).
- Employees should be aware of the location of all emergency equipment and should know how to use it if needed.
- Store and use pyrophoric chemicals under an inert atmosphere or under an appropriate liquid (e.g. kerosene, mineral oil, etc).
- See the above-referenced Aldrich technical bulletins for recommendations on safe transfer of liquid pyrophorics.
- Before conducting the actual procedure, always perform a dry run (without the pyrophoric material) to identify and resolve possible safety hazards. The initial reaction should be carried out at small scale to identify further safety concerns (e.g. how exothermic, release of gases, etc.).
- Inform other lab personal of the procedure being performed and work within sight and/or hearing of at least one other person who is familiar with the hazards and written procedures.

#### 5. **Personal protective equipment (PPE):**

Wear a fully buttoned, flame-resistant lab coat with sleeves extended to the wrists, along with safety goggles and standard nitrile laboratory gloves.  
Any use of large quantities (>50 mmol) needs to be approved by KWH.  
Note that personal clothing should not be of a type that may ignite (such as polyester or nylon).

6. **Transportation and Storage:**

- Store and use pyrophoric chemicals under an inert atmosphere or under an appropriate liquid (kerosene, mineral oil, etc.) as appropriate.
- Store in secondary containers (original packaging) until needed. Store away from flammables and oxidizers.
- Avoid areas with heat, flames, and water.
- Some of these materials may need to be kept below threshold temperatures.

7. **Waste Disposal:**

Waste pyrophorics should be disposed of immediately (they should NOT be allowed to accumulate), following the chemical hygiene plan.

8. **Exposures/Unintended contact:**

Contact RM&S for medical advice on occupational chemical exposures, **1-5037**. For an actual chemical exposure or injury, complete the work-related injury or illness report found at: <http://chemistry.nd.edu/safety/supervisors-report-of-injury-to-the-health-center.pdf>. If medical attention is needed, see <http://chemistry.nd.edu/safety/procedures-for-injury-illness-or-incident.pdf>.

9. **Emergency/Spill Procedures:**

In the case of a release of pyrophoric material, fire, or explosion in the lab, leave the area immediately and contact the Police by calling **911** from a campus phone or 574-631-5555 from a cell phone. The Police will contact the fire department, facilities and/or RM&S as needed.

10. **Training of personnel:**

Users must be given hands-on training for procedures/experiments involving pyrophoric or other highly reactive materials before beginning work and should not perform the task if they are unsure of the procedure.  
Hands-on fire extinguisher training is highly recommended. Contact the Notre Dame Fire Department at 1-6200 for more information or to set this up.  
All personnel are required to complete the General Lab Safety session run by RM&S and complete the annual online refresher course. This session includes an introduction to general chemical safety.  
Furthermore, training on these specific procedures must be performed by knowledgeable designee for all personnel working with pyrophoric materials). All personnel shall read and fully adhere to the laboratory- and chemical-specific SOP for any explosives, and shall document that they have read it by signing and dating the SOP.