PYROPHORIC MATERIALS: Guidelines for Safe Use and Handling in Laboratories

Laboratory personnel work in a potentially hazardous and extremely unforgiving environment. Guidelines and procedures are to be closely followed to reduce risks to a level as low as possible and provide a safe environment in laboratories.

Pyrophoric Materials

Basic Properties

Pyrophoric materials ignite spontaneously when exposed to air. This is the primary hazard and reagents must be handled so as to rigorously exclude air/moisture. Pyrophoric materials tend to be toxic and 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.

Controlling Hazards

- If possible, use safer chemical alternatives.
- Limit the amount purchased and do not accumulate unneeded pyrophoric reagents.
- Before working with pyrophoric reagents, read the relevant MSDS sheets and associated technical bulletins. The MSDS must be reviewed before using an unfamiliar chemical and periodically as a reminder.
- **PVC is possibly the most commonly used exhaust vent material used in laboratories these days. But PVC is affected by some pyrophoric materials. Notably among these are sulfur and carbon compounds. Please be aware of this and plan experiments accordingly.**

Safe Use and Handling

Safety Equipment

- Eye Protection:
  - Chemical Splash goggles or safety glasses must be worn whenever handling pyrophoric chemicals. Ordinary prescription glasses will NOT provide adequate protection.
  - A face shield is required any time there is a risk of explosion, large splash hazard or a highly exothermic reaction. Portable shields are also acceptable.
- Skin Protection:
  - Gloves must be worn when handling pyrophoric chemicals. Nitrile gloves should be adequate for handling most of these in general laboratory settings but they are combustible. Be sure to use adequate protection to prevent skin exposures. Sigma-Aldrich recommends the use of nitrile gloves underneath neoprene gloves.
  - Avoid wearing synthetic clothing while working with pyrophoric materials. **A lab coat or apron (not made from easily ignited material like nylon or polyester) must be worn.** Special fire-resistant lab coats made from Nomex are more expensive, but recommended for labs using these reagents routinely.
  - No open toe shoes are allowed.

Work Area

- Fume Hood:
  - Many pyrophoric chemicals release noxious or flammable gases and should be handled in a laboratory hood with the sash down at the lowest feasible position. In addition, some pyrophoric materials are stored under kerosene (or other flammable solvent); therefore the use of a fume hood (or glove box) is required to prevent the release of flammable vapors into the laboratory.
- Glove (dry) box:
  - Glove boxes are an excellent device to control pyrophoric chemicals when inert or dry atmospheres are required. When using a disposable plastic syringe, glove boxes are also recommended.

Important Experimental Steps

- A “dry-run” of the experiment should be performed using low-hazard materials, such as water or solvent, as appropriate.
- Conduct the procedure only after a supervisor has observed the user performing the proper technique unassisted.
- Working alone with pyrophoric materials is strongly discouraged.
- All glassware used for pyrophoric materials should be oven-dried and free of moisture.
- A container of powdered lime should be kept within arm’s length when working with a pyrophoric Material.
- Keep an appropriate fire extinguisher or extinguishing material close at hand. The recommended fire extinguisher is a standard dry powder (ABC) type. Class D extinguishers are recommended for combustible solid metal fires (e.g. sodium), but not for organolithium reagents.
- Secure the pyrophoric reagent bottle to a stand.
- Sigma Aldrich recommends the use of a long needle, 1-2 foot, and a syringe that is twice the volume of liquid that is to be transferred. Secure the syringe so if the plunger blows out of the body it, and the contents will not splash anyone. Avoid the transfer of large volumes (>20 mL) using a syringe. The cannula technique is recommended.

Storage

Pyrophoric chemicals should be stored under an atmosphere of inert gas or under kerosene as appropriate. Avoid areas with heat/flames, oxidizers, and water sources. Containers carrying pyrophoric materials 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.

Disposal

- All materials that contain or are contaminated with pyrophoric chemicals should be disposed of as hazardous waste. Proper and complete hazardous waste labeling of containers is vital.
- A container with residual material must NEVER be opened to the atmosphere.
- If the pyrophoric chemical was originally stored in solvent and is dried, please hydrate the chemical with an appropriate solvent before pick-up. The best solvent to use is the same solvent used for the solution of the original reagent.

Emergency Procedures

Small Spill

- Exert extreme caution due to potential spontaneous combustion and ignition of flammable solvents or other materials.
- If anyone is exposed, or on fire, wash with copious amounts of water, ideally in the lab shower.
- Carefully remove nearby flammable materials.
- Powdered lime (calcium oxide, CaO) or dry sand should be used to completely smother and cover any spill that occurs. Carefully quench by slow addition of isopropanol.
- After complete quench, double bag spill residues for hazardous waste pickup.
- If necessary, initiate the emergency plan and make the required emergency contacts.

Large Spill

In addition to the procedure listed above:

- Evacuate the spill area.
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering.
- Initiate the emergency plan and make the required emergency contacts. Provide emergency personnel with technical advice on the chemicals involved.