UC Irvine
Environmental Health & Safety

Pyrophoric Chemicals

REFERENCE GUIDE
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Pyrophoric liquids, solids, and gases may ignite spontaneously or react violently when exposed to air and must never be exposed to the atmosphere. Many are also water reactive. Care must be taken to ensure these materials are stored and handled properly in inert environments to avoid contact with oxygen, air, and moisture. Failure to follow proper handling procedures can result in fire or explosion, leading to serious injuries or death and significant damage to facilities. All labs using pyrophoric materials must have a Standard Operating Procedure (SOP) approved by the Principal Investigator (PI) that includes lab-specific procedures, reviewed and signed by all lab personnel.

Some examples of pyrophoric chemicals include Grignard reagents, metal alkyls and aryls, metal hydrides, alkali earth elements, metal carbonyls, finely divided metal powders, and non-metal alkyls.

Many pyrophorics are sold/used as solutions in flammable solvents, which may exacerbate any dangerous reactions that can occur with misuse of these reagents. In addition, pyrophoric chemicals tend to exhibit additional hazards such as target organ toxicity, reproductive toxicity, corrosivity, water reactivity, and peroxide formation.

Always review the Safety Data Sheet (SDS) and product information of the chemicals you are working with. Pyrophorics are identified on SDSs with the Globally Harmonized System (GHS) code H250 for pyrophoric liquids, solids, and gases, along with the hazard statement, “Catches fire spontaneously if exposed to air.”

Definitions

Pyrophoric: A chemical with an autoignition temperature in air, at or below a temperature of 54°C.

Pyrophoric Liquid: A liquid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air.

Pyrophoric Solid: A solid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air.

Pyrophoric Gas: Flammable gases that ignite spontaneously in air at a temperature of 54°C or below.

Cannula: A piece of stainless steel or plastic tubing used to transfer liquids or gases from one vessel to another without exposure to air.

Schlenk Line: Laboratory equipment used to transfer and manipulate air and water-sensitive materials without the use of an inert atmosphere glove box. It consists of a dual manifold in which the vacuum manifold is connected to a vacuum pump and the inert gas manifold is connected to a source of purified and dry inert gas (typically nitrogen or argon).

Glove Box: A sealed enclosure designed to create and maintain an inert environment free from air and moisture.

Storage Requirements

- Pyrophorics can only be handled and stored in fully sprinklered buildings.
- Must be handled and stored under an inert atmosphere at all times.
- Must be stored away from incompatible materials including combustibles, oxidizing acids, oxidizers, and aqueous solutions.
- Ensure sufficient protective solvent, oil, kerosene, or inert gas remains in the container while the material is stored.
- Store in an approved flammable storage cabinet, refrigerator/freezer rated for flammable storage, glove box, or desiccator. Note that storage in glove boxes and desiccators does not allow for an increase in the maximum amount that can be stored in the lab.
- It is best practice to store glass containers of pyrophoric material with protection, such as within a metal container or other suitable secondary containment. Avoid stacking glass bottles of pyrophorics on top of each other. Hairline cracks in glass bottles or inadvertant dropping can lead to fire and potentially serious injury.
- Use an appropriate secondary container, preferably one that can be sealed, and a cart with at least 2" lip to transport pyrophorics. Reference the Moving and Transporting Hazardous Materials Reference Guide for more information.

Handling

- **NEVER WORK ALONE.** At least one other person must be informed and present in the same room while work with pyrophoric chemicals is being conducted. If an incident occurs, another person there to help could be lifesaving, or at a minimum, help prevent serious injury.
- Pyrophorics can be transferred within a glove box or by using a proper syringe (locking tip), cannula, or Schlenk line when working in a fume hood. Syringes should not be used when transferring more than 20 ml of pyrophoric liquid.
- Never return excess chemical to the original container.
- Always have a container of powdered lime, dry sand, and/or liquid nitrogen within arm's reach to smother a small spill immediately. Always have a Class ABC fire extinguisher on hand, and Class D if combustible metals are involved. Never use a water or CO_2 fire extinguisher to put out a pyrophoric fire.

Glove Box

Schlenk Line

Cannula

Personal Protective Equipment

- A flame resistant Nomex® lab coat, long pants completely covering legs, and closed toe shoes. *Never wear synthetic clothing when working with pyrophorics.*
- If handling outside of a glovebox, fire-resistant hand protection is required; chemical resistant outer glove (neoprene) over approved fire-resistant (Nomex®) inner glove/liner.

- ANSI Z87.1-compliant safety glasses, or safety goggles if splash hazard is present. A face shield over safety glasses is recommended if an explosion or high fire hazard is present.

Waste Disposal

- Used pyrophoric should never be returned to the original container and must instead be quenched under an inert atmosphere with adequate cooling.
    - Follow a published quenching procedure from a reputable source for the material you are working with (i.e. a UC Standard Operating Procedure, National Lab procedures, other peer-reviewed publications).
    - Do not quench with water.
    - The following procedure can be used to quench the majority of pyrophoric and water reactive materials:
        - Add extra pyrophoric to a non-reacting solvent compatible with the pyrophoric, ensuring no exposure to air during the transfer process.
        - Ensure that pyrophoric residues are rinsed from inside glassware with non-reacting solvent compatible with the pyrophoric.
        - Slowly add isopropanol under an inert atmosphere while cooling and stirring.
- Ensure waste containers with pyrophoric residue are not left open to the atmosphere.
- All quenched pyrophoric, solvent, and residue rinses must be disposed of as hazardous waste. Keep pyrophoric waste separate from all other waste streams and ensure all contents are compatible.
- Hazardous waste must be transferred to Environmental Health & Safety (EHS) for disposal within 6 months of being generated.

Maximum Allowable Quantity (MAQ)

- Per the 2025 California Fire Code (CFC), pyrophorics can only be stored and handled in buildings that are fully equipped with an automatic fire sprinkler system. Even if your lab has sprinklers, they may not be installed throughout the entire building, and you cannot work with pyrophorics. Please confirm with EHS before ordering pyrophoric material.
- There are limits to the amount of pyrophoric material that can be stored within buildings, which must be adhered to at all times. These limits are determined by the CFC and are based on the building's construction attributes and ease of access for first responders. The amount of material that can be stored in a given area decreases drastically on higher floors.
- Storage capacity can increase with the use of approved storage solutions.
- Ensure that your lab is equipped to handle pyrophorics before purchasing and storing within your space. If you are unsure, contact EHS.
- The storage and use of pyrophoric gases may have additional requirements. Contact EHS before acquiring any pyrophoric gas.
- For more information on MAQs, visit the EHS Website MAQ Page and/or review the UC Irvine MAQ Reference Guide

References

- UC Irvine Chemical Hygiene Plan
- 2025 California Fire Code
- National Academies Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (2011)
- Moving and Transporting Hazardous Materials Reference Guide
- EHS Website MAQ Page
- UC Irvine MAQ Reference Guide
- UC Irvine Procedures for Safe Use of Pyrophoric Reagents

Contact EHS at (949) 824-6200 or safety@uci.edu for more information and questions regarding this guide.