1. **Purpose and Requirements**

The following guidance document assists researchers develop lab specific standard operating procedures for the storage and transport of pyrophoric gases. Each physical state has unique hazards but gases classified as pyrophoric gas often will ignite immediately when in contact with normal atmosphere. Understanding how to store and transport gas cylinders properly is a vital piece of working safely. These chemicals must be handled with care as they are extremely reactive toward oxygen, and if exposed, ignition could cause serious burns or other injuries to the person handling the gas or others in the immediate area.

2. **Responsibilities**

The Principal Investigator (PI) is responsible for ensuring all users in labs under their supervision are made aware of hazards in their lab(s), such as pyrophoric materials, received the appropriate training, adhere to lab specific standard operating procedures, and are provided with the appropriate personal protective equipment (PPE). In the case of work with pyrophoric chemicals, lab users should wear flame resistant lab coats, gloves, and safety glasses (or safety googles and face shield), in addition to other PPE as determined by their PIs.

Lab users who plan to work with pyrophoric chemicals should take the “Working Safely with Pyrophoric Chemicals” training class provided by the Department of Environmental Health and Safety (EH&S), in addition to any lab specific training provided by their PI.

Lab users working with pyrophoric materials are strongly encouraged to use a “buddy system”, as described in the Cornell University Laboratory Safety Manual, whenever handling pyrophoric materials or other highly hazardous substances or performing other highly hazardous operations.

3. **Procedure Instruction**

Please note, the PI may have a preferred method for storage and transport of pyrophoric gases other than as described here. Users of pyrophoric materials should always consult with their PI and lab specific standard operating procedures before carrying out any procedures with pyrophoric materials.

3.1 **General Information**

A gas with an auto-ignition temperature in air at or below 130°F (54.40°C) is considered pyrophoric. Examples of pyrophoric gas are arsine, silane, disilane, dichlorosilane, diborane, and phosphine. All of these gases have 3 things in common:

1. They can ignite immediately upon exposure to air.
2. They are all nonmetallic hydrides.
3. Many compounds which contain these gases in their molecular structure are also pyrophoric.

Silane has caused major losses due to fires in ducts, gas cabinets and supply system; and
explosion in ducts, vacuum pumps and cross-contaminated cylinders. These incidents have occurred in research facilities, and due to the nature of pyrophoric fires, are difficult to extinguish.

3.2 Storage Information

Note: Gas Cabinets are required for Pyrophoric Gases

1. Due to their hazardous nature, pyrophoric gases must be stored in gas cabinets to protect the occupants of the space.

2. Outside each gas cabinet, devices for remote manual shutdown of pyrophoric gas flow should be provided.

3. Automatic shutdown devices for pyrophoric gas flow activated by interlocks tied into fire protection and/or detection should be protected.

4. Pyrophoric gas flow, purge, and exhaust systems should have redundant controls that prevent pyrophoric gas from igniting or exploding.
   a. These controls include: excess flow valves, flow orifices, mass flow controller sizing, process bypass line control, and automatic gas shutdown.

5. Emergency back-up power should be provided for all electrical controls, alarms and safeguards associated with the storage and process systems.

6. All process system components and equipment should be purged with a dedicated inert gas cylinder.

7. Pyrophoric storage and dispensing areas should be located on the exterior of the building, or in an approved shelter.

8. Mechanical or natural ventilation at a minimum of .00047 cubic meters per .09 square meters of storage and dispensing area should be provided.

3.3 Transport of Pyrophoric Gas Cylinders

The cylinders that contain compressed gases are primarily shipping containers and should not be subjected to rough handling. Such misuse can seriously weaken the cylinder and render it unfit for further use or transform it into a rocket having sufficient thrust to drive it through masonry walls.

1. To protect the valve during transportation, the cover cap should be screwed on hand tight until the cylinder is in place and ready for actual use.

2. Cylinders should never be rolled or dragged.

3. When moving large cylinders, they should be strapped to a properly designed wheeled cart to ensure stability.

4. Only one cylinder should be handled at a time.
4. Reference

- Sigma-Aldrich Technical Bulletin AL-134 – Handling Air-Sensitive Reagents
- Sigma-Aldrich Technical Bulletin AL-164 – Handling Pyrophoric Reagents
- University of Minnesota, Environmental Health and Safety – “Pyrophoric Chemicals Guide”
- Tufts University, Environmental Health and Safety – “SOP for Pyrophoric Chemicals”
- UC Irvine, Environmental Health and Safety – “Pyrophorics Safety”
- UCLA, Environmental Health and Safety – “Pyrophoric Liquid Safety Video”