

SOP 6. Standard Operating Procedure for Compressed Gases

I. General Statement of Coverage

Cylinders of compressed gases represent high-energy sources and should be handled with regard to their potential hazards. The chemical reactivity of the gases should also be taken into account when planning for safe management and use of compressed gases.

II. Hazard Assessment

A Job Hazard Assessment should be performed for work involving materials under pressure and should address the issues of proper use and handling, chemical toxicity, storage, disposal, spill response, and required PPE. See Section 21 and Form 4 of Section 25 of the Chemical Hygiene Plan. Specifics may include: that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the material and pressure(s) used; and all system components are leak-tested.

III. Resources

A. Available Training

Chemistry 685

EHS/Chemistry Lab Safety Course

B. Text and Literature References

Department of Chemistry Safety Handbook

C. CHP Appendix III (Section 23.3) Chemical Information Tables

Table 9. Common Gas Properties

IV. Chemical Storage

A. Special Storage

1. Cylinders should be stored in an upright position and secured to a wall or laboratory bench through the use of chains or straps. Cylinder caps should remain on the cylinder at all times unless a regulator is in place. Cylinders should be stored in areas where they will not become overheated. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers.
2. Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand.

B. Gas Cylinders

Cylinders of compressed gases must be handled as high-energy sources. They pose a serious hazard if the cylinder valve is dislodged.

C. Securing Cylinders

When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders. Securing cylinders individually is preferred. Cylinder supports should be designed to restrict cylinders from falling or toppling over.

V. Personal Protective and Emergency Equipment

A. Eye and Face Protection

Refer to the Eye Protection Policy, Appendix IIB (Section 23.2). At a minimum, safety glasses with permanently attached top and side shields must be worn in the laboratory. These glasses, however, do NOT protect against splash hazards. When performing a hazardous activity, a face shield must be worn in addition to the safety glasses OR switch to chemical splash goggles (with shielded ventilation ports). Face shields are available from the Safety Office (free of charge).

- B. **Gloves**
Appropriate gloves should be worn when handling hazardous materials. The selection of glove materials should be made from Appendix II, Part A (Section 23.2) of this document. If this chart is insufficient, please see the Safety Coordinator/CHO.
- C. **Protective Clothing**
Lab coats, closed toed shoes and long sleeved clothing should be worn when handling hazardous materials. Additional protective clothing, such as aprons or full-length arm protection, should be worn if the possibility of skin contact is likely.
- D. **Hearing Protection**
The use of hearing protection requires monitoring and training. See the Safety Coordinator/CHO for details.
- E. **Respirators**
The use of respirators require medical certification, fit testing, and training. See the Safety Coordinator/CHO for details.
- F. **Eye Wash**
Where the eyes or body of any person may be exposed to hazardous materials suitable facilities for quick drenching or flushing of the eyes and body shall be provided within, or near, the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.
- G. **Safety Showers**
A safety shower should be available and functioning as specified by ANSI Z358.1.
- H. **Fire Extinguishers**
All laboratories must contain at least one Carbon Dioxide (Type B-C) or Dry Chemical (Type A-B-C) fire extinguisher. Additional fire extinguishers are located near exits and/or stairwells in each building. Special Class D fire extinguishers (for certain metal fires) are available from the Safety Office.

VI. **Controls**

- A. **Designated Areas**
Some compressed gases such as Chlorine, Chlorine Dioxide, Chlorine Trifluoride, Cyanogen Chloride, Cyanogen Fluoride, Fluorine, Formaldehyde, Nitrogen Tetroxide, Nitrogen Trioxide, Nitrous Oxide, Oxygen Difluoride, Ozone, Phosgene, Phosphine, require Designated Areas. See Section 18 of the CHP.
- B. **Chemical Fume Hoods**
Use compressed gases in a chemical fume hood or glove box whenever possible. With a fume hood, use portable safety shielding and work with the sash as far down as feasible (see below). Also, refer to the SOP on using glove boxes.
- C. **Glove Boxes**
Refer to SOP 14.
- D. **Safety Shielding**
Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of compressed gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.
- E. **Special Ventilation**
Special ventilation is required if these materials are used outside of a fume hood. If your research does not permit the handling of hazardous chemicals in a fume hood, contact the Chemical Hygiene Officer or the Division of Environmental Health and Safety to review the adequacy of all special ventilation.

F. **Vacuum Protection**

1. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving flammable liquids must be conducted in a fume hood, glove box or isolated in an acceptable manner.
2. Mechanical vacuum pumps and the “House Vacuum System” must be protected using cold traps and, where appropriate, filtered to prevent particulate release. See the article in the Department Safety Handbook under “Compressed Gases.” The exhaust for the pumps must be vented into an exhaust hood.

G. **Signs and Labels**

1. Doorways: All OSHA Select Carcinogens, Reproductive Toxins, Highly Toxic materials, and NFPA Level 4 Flammable Liquids (Section 23.3, Tables 10-15) must be indicated on the acrylic door sign.
2. Containers: All hazardous materials must be clearly labeled with the correct chemical name.

H. **Utilities**

In Evans and Celeste Labs, utility shut-off valves are located in pipe chases just outside of the laboratories. In Newman/Wolfrom, the valves are located above the ceiling in the hallways. Look for the ceiling tiles with the green dots.

I. **Fire Protection**

Older buildings, such as Evans and Johnston Labs, do not have sprinkler suppression systems. This could be a consideration for storing or using large quantities of hazardous materials.

VII. **Specific Procedures**

Some gases such as Carbon Monoxide, Anhydrous Hydrogen Fluoride, Fluorine, Hydrogen Cyanide, Cyanogen or high-pressure hydrogenation require prior approvals. See Section 20 of the CHP.

Refer to the MSDS or other sources of information to become familiar with the properties of the particular substances including: chemical and physical properties, health hazard information, symptoms of over-exposure, etc.

Hazardous gas systems should be leak tested. This can be accomplished in many ways. The simplest way is to use “Snoop” or a soap solution to indicate leaking gas. For gases requiring prior approval, gas handling systems can be tested with pressurized air or nitrogen prior to charging with a more hazardous gas.

VIII. **Emergency Procedures**

A. **Notification**

Refer to the “Emergency Response” section of the Department Safety Handbook for generic emergency response procedures. Specific emergency procedures should be developed for each group or laboratory. The procedures should address as a minimum the following:

1. Who to contact: (University police at 292-2121 or 292-2525, and Division of Environmental Health and Safety at 292-1284 during normal working hours, and the Principal Investigator of the laboratory including evening phone number).
2. The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.).
3. The location and quantity of all hazardous chemicals in the laboratory.
4. The method used to alert personnel in nearby areas of potential hazards.

B. Spill Response

1. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any hazardous chemicals. Spill control materials for sensitive chemicals are designed to be inert and will not react with the reagent. Do not put water on the spill.
2. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of sensitive chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call 911 for assistance.
3. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

IX. Decontamination and Waste Disposal

A. Decontamination Procedures

1. Personnel: Wash hands and arms with soap and water immediately after handling water any chemicals.
2. Area: Carefully clean work area after use.
3. Equipment:

B. Waste Disposal

All materials contaminated with water sensitive chemicals must be disposed of as hazardous waste. Alert the Chemical Hygiene Officer or the Division of Environmental Health and Safety if you generate wastes contaminated by sensitive chemicals. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

X. Approvals

Some hazardous materials require special handling or prior approvals. See Sections 18 and 20 of the CHP.

XI. SOP Prepared by _____ Date _____

Reviewed by _____ Date _____