Syracuse University

Laboratory Guidance Document

Compressed Gas

This Laboratory Guidance Document was created by Syracuse University Environmental Health & Safety Services (EHSS) to assist researchers in developing laboratory specific standard operating procedures for the storage, handling, and disposal of compressed gases.

Potential Hazards

Compressed gases are gases that are stored, pressurized in cylinders. The storage and use of a compressed gas can pose health, flammable, physical hazards.

1. **Health Hazards**
   - Oxygen Displacement
     If a rupture, leak, or release of a compressed gas (even inert gas) occurs in laboratory, the gas may displace oxygen in the room, which can result in an oxygen-deficient atmosphere. An oxygen-deficient atmosphere is defined by OSHA as one that contains less than 19.5 % oxygen. Oxygen-deficient atmospheres can result in negative health consequences, even death, depending on the concentration of oxygen in the room.
   - Toxic Gases
     High pressure gas cylinders that contain a toxic gas present the greatest immediate health risk. Even relatively small leaks of toxic gas can disperse quickly leaving little time to react. Accidental exposure to a toxic gas may result in burns to eyes, nose and lungs, and inhalation of acutely toxic material (even at low concentrations) can have severe health consequences.

2. **Flammable Hazards**
   Leaking hose connections, faulty valves, and ruptured cylinders can release flammable gases that may accumulate in spaces. The accumulated gas may ignite if ignition sources, such as, electrical outlets, switches, or open flames are present.
   - Flammable Gases, such as hydrogen, are flammable and can easily catch on fire if exposed to an ignition source.
   - Gases, such as oxygen, are oxidizers and can increase the potential of a fire starting and can increase the intensity of a fire.
   - Even more dangerous, clouds of flammable gases ignite easily and burn explosively.

3. **Physical Hazards**
   - High Pressure
     Compressed gases come in gas cylinders under high pressure. A typical laboratory cylinder is filled to a pressure of 2,400 pounds per square inch, and contain approximately 300 cubic feet of atmospheric pressure gas. This compression of gas represents a tremendous amount of stored

energy. If the gas cylinder is punctured or broken, all the gas in the cylinder will release which may result in a projectile.

Properties:

There are three different categories of compressed gases that come in cylinders.

Non-Liquefied Gas

Compressed gases that when under pressure in a gas cylinder remain as a gas, some common examples are argon, nitrogen, and oxygen.

Liquefied Gas

Compressed gas that when under pressure in a gas cylinder become a liquid, some common examples are carbon dioxide and propane.

Dissolved Gas

Compressed gas that are stored in gas cylinders dissolved in a liquid. This is done to help stabilize the gases that may not be stable under pressure or may react within the cylinder if not dissolved. One example is acetylene, which when pressurized can explode but when it is dissolved in acetone it reduces the pressure and prevents explosion.

General Precautions:

Working with any gas cylinder requires thorough planning and the consistent application of good work practices and skills to control the hazard while achieving the goal of the experiment.

1. **Training**

The Principal Investigator is responsible for ensuring all personnel under their supervision are aware of the hazards associated with compressed gases, have received appropriate hands-on training, adhere to the laboratory standard operating procedures, and are provided with the appropriate personal protective equipment.

2. **Awareness**

Prior to working with a compressed gas, a hazard assessment should be conducted, evaluating the gas for potential hazards (flammable, toxic, oxidizer) and a plan for reducing the hazards put into place. This may include engineering controls (e.g. ventilation), administrative controls (e.g. standard operating procedures), and gas monitoring.

Personal Protective Equipment (PPE):

In addition to the standard laboratory attire (i.e., long pants and closed toe shoes), the following PPE is recommended:

- ANSI certified (Z87) chemical splash goggles
- Knee-length lab coat
  NOTE: A flame resistant (FR) lab coat should be worn when working with gases that are also flammable.
- Nitrile gloves

Best Practices for the Safe Operation of Compressed Gases

- Gas cylinders must be capped when not in use or doing transport.
- Compressed gas cylinders are to be transported using secured hand trucks. A gas cylinder should NEVER be transported unsecured.
- Transportation of gas cylinders on secured hand trucks should be performed by pushing the hand truck and not by pulling.
- Never drag, lift, or move a cylinder using the valve as a handle.
- If the gas cylinder contains a toxic or flammable gas, a gas monitor may be required.
- Routinely check gas cylinders visually using a soap-water mixture and looking for bubbles to determine if any leaks are present.
- Gas cylinders should be equipped with the appropriate regulator for the gas in the cylinder. This can be determined by consulting with the gas distributor.
- Never use Teflon tape on cylinder-regulator connections, only on pipe threads.
- A regulator should not be altered to fit onto a gas cylinder that it was not made for, this can lead to gas leaks and serious accidents.
- Use "hard piping" such as copper or stainless steel whenever possible and avoid the use of flexible or plastic tubing.
- Select tubing that is compatible with the chemical and pressure requirements for the gas being used in the system.
- For toxic gases, regulators, valves, piping, tubing, must be purged after use.
- Valves, fittings, and connections should be kept free of oil or grease, which may react with the gas in the cylinder.
- When purging a gas from an experiment using a vacuum pump, ensure that the vacuum pump is compatible with the gas being removed (e.g. lubricants used in vacuum pump).

Storage Considerations:

Federal, State, and Local regulations restrict the number of gas cylinders that can be stored in a laboratory. Contact EHSS (315-443-4132 or ehss@syr.edu) for more information.

- Gas cylinders should be stored upright (full or empty), secured by a two-point restraint system (e.g. chain, strap), and capped when not in use.
- Store gas cylinders in a dry, secure, and well-ventilated area away from ignition and combustion sources.
- Segregate full and empty cylinders and use follow the "first in, first out" inventory control method.
- Gas cylinders should be segregated by contents (e.g. flammables stored separately from oxidizing gases)
- Store cylinders away from heavily traveled areas and emergency exits.
- Visually inspect stored cylinders on a routine basis; look for indication of leakage and cylinder defects.
- Never attempt to fully empty or "bleed" a compressed cylinder, even inside a fume hood.
- Promptly return empty cylinders to the vendor. Do not purchase non-returnable cylinders.

Waste Management and Disposal:

- Liquid or solid hazardous waste byproducts of reactions with compressed gases must be disposed of as hazardous waste.

- Used gas cylinders should be returned to the vendor. If they cannot be returned to the vendor, notify the EHSS Hazardous Waste Group at 315.443.9132 for disposal.

First Aid:

The chemical's SDS should be readily available and used as a reference for determining appropriate first aid measures. The following information provides typical first aid measures recommended for chemical exposures.

1. **Skin Contact:** Remove all contaminated clothing and rinse affected area with water for at least 15 minutes.
2. **Eye Contact:** Flush with water at an emergency eyewash station for at least 15 minutes.
3. **Ingestion:** Seek medical attention immediately.
4. **Inhalation:** Move to fresh air and seek medical attention immediately.

Incident Response:

All laboratory emergencies must be reported to the Department of Public Safety at 315-443-2224.