

Compressed Gas & Cryogenic Liquid Cylinder Safety

Introduction

Some CMNBTR laboratory operations require the use of compressed gases for a variety of different operations. Depending on the particular gas or cryogenic liquid, there is a potential for mechanical and chemical hazards. Everyone should be aware of the hazards associated with compressed gases & cryogenic liquids and their cylinders before using or transporting them. All individuals who work with compressed gasses and cryogenic liquids must read the SDS of the agent before handling. They must use proper Personal Protective Equipment (PPE), if needed, when working with or handling the cylinders.

Dangers of Compressed Gas & Cryogenic Liquid Cylinder

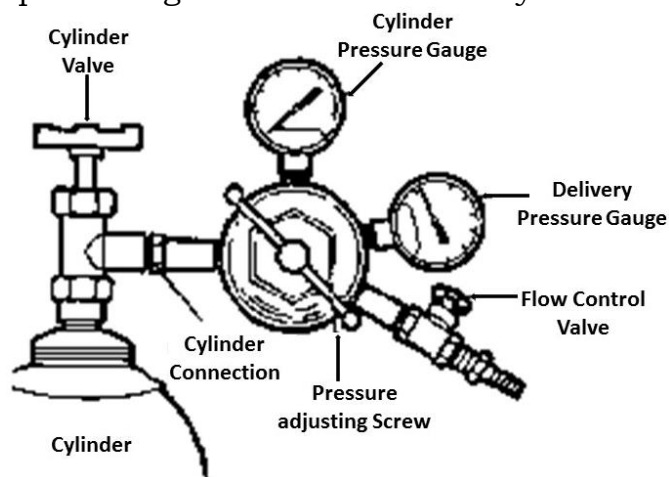
Compressed gases and cryogenic liquids are contained in heavy, highly pressurized metal containers; the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb. Inert gases can produce conditions of oxygen depletion that could lead to asphyxiation.

Many cylinders contain pressures that are in excess of 2000 pounds per square inch. A broken valve can cause a cylinder to become an unguided missile. Never deliberately breathe, or allow others to breathe any compressed gas of any type. This can cause a depletion of oxygen in the bloodstream and/or poisoning, leading to rapid suffocation and death.

General Handling and Operation

All users must follow the CMNBTR policies for PPE when working with compressed gases and cryogenic liquids.

The figure below depicts a regulator attached to a cylinder



- Hand, eye, body and respiratory protection should be determined prior to the use of any compressed gasses.
- Cylinders with regulators usually have a number of valves, and individuals using the cylinders need to know the function of each valve before use.
- Use of safety glasses (preferably with a face shield) when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines is recommended.
- All laboratory workers must be trained in proper handling of compressed gas cylinders and recorded by PI. Compressed gases must only be handled by experienced and properly trained individuals.
- Laboratory workers must have proper equipment for fitting and securing a cylinder, including valves, regulators, wrenches, tubing, straps, racks, chain and clamps.
- Cylinders must be kept in an upright position and must be secured with chains or straps to an immovable object.
- Small cylinders must not be kept in drawers or cabinets. They must be kept in an upright position and secured with a chain or strap.
- The cylinder's valve must be closed at all times, except when in use.
- Wrenches or other tools must not be used for opening and closing valves. If a valve is not working, have it inspected and fixed.
- Leave the valve protection cap in place until the cylinder is secured.
- Valve protection caps should remain in place until ready to withdraw gas or connected to a regulator or manifold.
- Do not force connections that do not fit.
- When extracting gas from a cylinder, increase the flow rate slowly and inspect the system for leaks.
- All compressed gas cylinders must have safety pressure relief valves.
- Use the cylinder valve for turning gas off, not the regulator.
- Never heat a cylinder to raise the pressure of the gas (this can defeat the safety mechanisms built in by the supplier).
- Safety relief devices in the valve or on the cylinder must be free from any indication of tampering.
- Laboratory workers must monitor for leaks and ensure proper labeling.
- All compressed gas cylinders must regularly be inspected for corrosion, pitting, cuts, gouges, digs, bulges, neck defects, general distortion.
- All compressed gas cylinders must have their contents and precautionary labeling clearly marked on their exteriors.
- Empty, damaged and surplus cylinders must not be stored in the laboratory.
- Never attempt to adapt fittings from one cylinder or regulator to another.
- Fittings or hoses must be compatible with the gas in the cylinder.
- Gases must never be transferred from one cylinder to another.
- Cylinders must not impede movement through isles or prevent egress in the event of an emergency.
- Never lubricate any part of the valve, cylinder, or attached equipment.
- Keep the cylinders in a dry, cool and well-ventilated area.

- Incompatible gas cylinders must be properly separated. Oxygen and flammable gas cylinders must be separated by a minimum of 20 feet.
- When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- Before removing a regulator from a cylinder, close the cylinder valve and release all pressure.
- Label all empty cylinders with tags so that everyone will know their status. Handle empty cylinders as carefully as full ones; residual pressure can be dangerous.
- **In the event of a fire, call 9-911 from a campus phone or 911 from a cell phone.**

Hazardous Gases

Hazardous gases include both toxic gases and gases that create fire hazard. Hazardous gases must be stored in vented cabinets, fume hoods, or specially designed vented equipment. Fuel cylinders should be stored in vented cabinets separate from oxygen cylinders.

Some examples of hazardous gases include: O₂, H₂, HCl, HF, H₂S, NH₃, NO, NO₂, SO₂, acetylene and halogen gases (Cl₂, Br₂, F₂).

Safety Tips

- Choose piping and fittings appropriate for the chemical and pressure used.
 - Do not use adaptors
 - Only use compatible regulators
- Before using a cylinder, verify that the correct gas is selected.
- When installing a cylinder check for leaks around the valve connections.
- When a cylinder is empty, close the valve, check for leaks, and remove the cylinder.
 - Securely recap the cylinder and attach a tag/sticker to identify the cylinder is empty

Pressure Regulators for Cylinders

- Use the appropriate regulator for the type of tank and gas being used.
- Do not use any oil, grease, mercury or soapy water on regulator valve.
- Check that the regulator is free of foreign objects.
- Relief valves must be vented to a laboratory chemical hood or other safe location.
- Never attempt to repair a gas leak when the system is still pressurized or venting gas.
- While a cylinder is not being used, the regulator must be removed.

Steps to open a cylinder

When opening the cylinder follow these steps:

1. Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.
2. Open the valve slowly and only with the proper regulator in place.
3. Never leave pressure in a regulator when it is not in use.
4. Stand with the cylinder between yourself and the regulator (cylinder valve outlet facing away) when opening the cylinder valve.
 - a. Acetylene or other flammable gas cylinder valves should not be opened more than $\frac{1}{2}$ turns of the spindle, and preferably no more than $\frac{3}{4}$ of a turn. This reduces the risk of explosion and allows for the cylinder valve to be closed quickly cutting off the gas flow.
 - b. Do not use acetylene at operating pressures above 15 psig.
 - c. Oxygen cylinder valves must be opened all of the way during use.

Transportation and Storage of Cylinders

- Use proper PPE when transferring or moving cylinders
- Always inspect cylinders before transferring
- Before moving cylinders, regulators must be removed, valves must be closed and the cap must be securely in place.
- Only use an approved wheel cylinder carts for the transportation of cylinders. Never use carts for storage.
- When moving a cylinder on a wheeled cylinder cart, the cylinder must be secured to the cart with a chain or strap.
- Never drag, slide or roll a cylinder.
- Do not drop cylinders or strike them against each other or against other surfaces violently.
- Do not use the valve cover to lift cylinders; they could be damaged and become unattached.
- Always secure cylinders to structural supports that are permanently affixed to the floor, wall, or ceiling.
- It is permissible to store up to 3 capped cylinders together, however, if uncapped the cylinders should be secured individually.
- Do not secure cylinders near any heat source such as incubators, water baths, hot plates, or burners
- Never store cylinders in poorly ventilated rooms.
 - Because compressed gases and liquids rapidly displaces oxygen in a room, suffocation is a possibility in a poorly ventilated room
 - Oxygen cylinders opened in a poorly ventilated room can quickly enrich the atmosphere creating an atmosphere where a small spark can cause an explosion and a deadly fire

Preventing and Controlling Leaks

- Laboratory workers must check the cylinder's connections and hoses regularly for leaks.
- Convenient ways to check for leaks include flammable gas leak detectors (for flammable gases only) or a 50% glycerin in water solution. Bubble-forming solutions and leak detectors are available commercially. **Never use a flame for leak detection.**

The following procedures must be used when a compressed gas cylinder leak cannot be remedied by simply tightening the valve:

- Attach a tag to the cylinder stating it is unserviceable.
- If the cylinder contains a **flammable, inert, or oxidizing gas**, remove it to an isolated area, away from possible ignition sources.
 - Allow it to remain isolated until the gas has discharged, making certain that appropriate warnings have been posted.
- If the gas is **corrosive**, remove the cylinder to an isolated, well-ventilated area. The stream of leaking gas should be directed into an appropriate neutralizing material.
- If the gas is **toxic**, remove the cylinder to an isolated, well-ventilated area, but only if this is possible while maintaining personal safety. It may be necessary to evacuate the facility.
- Notify the gas supplier and follow his/her instructions as to the return of the cylinder.
- If any risk of exposure exists, call the EH&S and evacuate the area before the tank is moved.
- For major leak, all laboratory workers must evacuate the laboratory immediately, close the doors and contact **EH&S**