



# Compressed Gas Cylinder Procedures

Office of Environmental  
Health and Safety

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## Scope

This document provides information on the safe use of compressed gas cylinders used on the University of Arkansas campus. It outlines safe work practices and guidelines to ensure the health and safety of individuals using compressed gases in the workplace. The contents of the manual are based on current federal and state work place guidelines and recommendations. Failure to comply with instructions contained in the manual may result in a violation of the regulations, codes, and laws that prompted these guidelines and recommendations.

## Purpose

Depending on the properties of a particular gas, there may be potential for simultaneous exposure to any of the following types of hazards.

- Decompression
- Flammability and Explosion
- Asphyxiation
- Toxicity
- Cryohazard
- Physical Hazard (e.g., weight)

No employee shall use any compressed gas cylinder without training in the safe use of these cylinders.

## Responsibilities

### Supervisors

- Ensure that all requirements listed in the written program for CGCS are met.
- Ensure new and existing employees are familiar with the CGCS program as applicable to their job duties.
- With the assistance of Environmental Health and Safety (EH&S), identify CGCS hazards.
- Arrange for required training of university employees in CGCS.

### Employees

- Employees whose duties involve working with CGC are required to comply with guidelines and safety practices outlined in this procedure.

### Office of Environmental Health and Safety

- Assist in hazard identification, provide training, and assure general oversight of the program.

## Definitions

### Asphyxiation

Liquefied gases may expand as much as 1000-fold in volume when vaporized. When the content of a large cylinder is vented very rapidly, oxygen deficiency or even asphyxiation may occur due to atmospheric displacement.

### Cryohazard

Liquefied gases such as carbon dioxide and nitrogen can cause immediate frost burns on exposed skin. Even very brief contact with a cryogenic liquid is capable of causing tissue damage similar to that of a thermal burns.

Prolonged contact may result in blood clots that have potentially serious consequences. In addition, surfaces cooled by cryogenic liquids can cause severe damage to the skin. Gloves and eye protection (preferably a face shield) should be worn at all times when handling cryogenic liquids.

### **Decompression**

Sudden decompression can propel a cylinder with enough force to penetrate walls. When the gas pressure is released rapidly through an opening the size of the valve stem, a cylinder can reach velocities of close to 66 mph. Since the gases 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 capable of causing catastrophic property damage, personal injury, and death if they are not handled properly.

### **Flammability or Explosion**

If the gas is flammable, flash points lower than room temperature present a danger of fire or explosion. Adequate ventilation must always be used to prevent the build-up of vapors of flammable gases such as hydrogen, methane, and acetylene. Adequate ventilation is also required when using gases such as nitrogen or helium. In these cases, oxygen can be condensed out of the atmosphere creating a potential for explosive conditions.

### **Physical Hazard**

An empty cylinder can weigh up to 200 lbs. or more depending on the size of the cylinder and the density of the gas contained within. No one should attempt to lift a cylinder that weighs more than 50 lbs.

### **Toxicity**

Once a victim has been removed from the area of exposure, the immediate effects of the gas exposure (e.g., dizziness or difficulty breathing) may diminish rapidly. However, the SDS must always be consulted for toxicological information prior to working with any gas.

The following table categorizes these hazards per gas type:

**Table 1: Hazard classes for commonly used compressed gases.**

Gas	Decompression	Flammability	Asphyxiation	Toxicity	Cryohazard
Acetylene	X	X	X		
Air	X				
Argon	X		X		X
CO2	X		X	X	X
Chemical Reagents (reactive)	X	X	X	X	
Helium	X		X		X

Hydrogen	X	X	X		X
Nitrogen	X		X		X
Oxygen	X	X			X
Propane	X	X	X		

## Application

### Identification

No compressed gas cylinder shall be accepted for use that does not legibly identify its contents by name. Color coding is not a reliable means of identification. Cylinder colors vary with the supplier, and labels on caps have little value, as caps are interchangeable. If the labeling on a cylinder becomes unclear or an attached tag is defaced to the point the contents cannot be identified, the cylinder should be marked "contents unknown" and returned directly to the manufacturer.

### Caps

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

### Transport

Cylinders that contain compressed gases are primarily shipping containers and should not be subjected to rough handling or abuse. They are built to be as light as possible while remaining safe and durable. Do not drop cylinders or otherwise allow them to strike each other. Such misuse can seriously weaken the cylinder and render it unfit for further use or may transform it into a rocket having sufficient thrust to drive it through masonry walls. Cylinders should never be rolled or dragged. When moving large cylinders, they should be strapped to a properly designed wheel cart or hand truck to ensure stability. Never transport a cylinder with a regulator in place. Always protect the valve during transport by replacing the valve cover. Only one cylinder should be handled at a time. Rolling cylinders on their bottom edge ("milk churning") may be acceptable only for very short distances, as when moving a cylinder into place or onto a cart.

### Restraint

Since gas cylinders are tall and narrow, they should be secured in an upright position at all times to prevent tipping. Never lay any cylinders, especially those containing flammable gases, on their sides. Cylinders may be attached to a bench top, individually to the wall, placed in a holding cage, or have a heavy non-slip base attached. Cylinders should be affixed with a bracket to a permanent building fixture such as a bench or wall during use. Brackets that can be screwed into the mounting surface are preferred over clamp-type brackets. It is recommended that cylinders be secured at two locations, at the lower and upper portion of the tank or at a single position where toppling or sliding out from underneath is not probable.

### Storage

Cylinders containing flammable gases such as hydrogen or acetylene shall not be stored in close proximity to open flame, areas where electrical sparks are generated, or where other sources of

ignition may be present. An open flame shall never be used to detect leaks of flammable gases. All cylinders containing flammable gases should be stored in a well-ventilated area. Store oxidizing gases at least 20 feet away from fuel gases or other combustible materials, or separate them with an approved firewall. Check the reactivity information and storage requirement sections of the SDS for details about which materials are incompatible with a particular compressed gas.

Cylinders should be placed with the valve accessible at all times. The main cylinder valve should be closed as soon as it is no longer necessary that it be open (i.e., it should never be left open when the equipment is unattended or not operating). This is necessary not only for safety when the cylinder is under pressure, but also to prevent the corrosion and contamination resulting from diffusion of air and moisture in to the cylinder.

Do not store cylinders in exit or egress routes. Do not store unused cylinders longer than one year. If compressed gas cylinders are stored outside, use a well-drained, securely fenced, and preferably covered area. Keep them on a level, raised concrete pad or non-combustible rack. To prevent excessive pressure buildup, never expose cylinders to temperatures above 52°C (125°F). Some rupture devices will release at approximately 65°C. Do not subject them to temperatures below -29°C (-20°F), unless they are designed for this. Cylinders that become frozen to a surface can be freed by using warm water (less than 52°C). Never apply direct heat to a cylinder.

### **Appliances and Fittings**

Discharge compressed gases safely using devices (i.e., pressure regulator) approved for the particular gas. Standard cylinder-valve outlet connections have been devised by the Compressed Gas Association (CGA) to prevent mixing of incompatible gases.

The outlet threads used vary in diameter; some are internal, some are external; some are right-handed, and some are left-handed. In general, right-handed threads are used for non-fuel and water pumped gases, while left-handed threads are used for fuel and oil-pump gases. To minimize undesirable connections, only CGA standard combinations of valves and fittings should be used in compressed gas installations; the assembly of miscellaneous parts should be avoided. These CGA fitting designations can be found inscribed on the inlet nut of the regulator.

- Helium CGA-580
- Hydrogen CGA-350
- Argon CGA-580
- Nitrogen CGA-580

The threads on cylinder valves, regulators and other fittings should be examined to ensure they correspond and are undamaged. Never force connections or use homemade adapters. Do not lubricate any cylinder valves, fittings, or regulator threads, or apply jointing compounds or tape. Use only lubricants and sealants recommended by the gas supplier. After the regulator is attached, the cylinder valve should be opened just enough to indicate pressure on the regulator gauge (no more than one full turn) and all the connections checked with a soap solution for leaks. Never use oil or grease on the regulator of a cylinder valve. Carefully check all cylinder-to- equipment connections before use and periodically during use, to be sure they are tight, clean, in good condition and not leaking. Carefully open all valves slowly, pointed away from you and others using proper tools. Close all valves when cylinders are not in use. Never tamper with safety-relief devices on cylinders, valves, or regulators. Grit, insects, dirt, oil, or dirty water can cause gas leaks if they get into the cylinder valve or gas connection. Use a lint-free tissue to remove any dirt or rust. (Never open the high-pressure cylinder valve to clean the fitting seat.) Never open a damaged valve. Contact your gas supplier for advice. If you suspect the regulator is leaking, return it to the vendor for repair. Never attempt to repair a regulator, valve, or safety device yourself.

## Tubing

Instrument connecting tubing and fittings must also be rated to the gas used. They must be able to withstand the highest possible pressure to which they could be subjected in the event of pressure regulator failure.

## General

Read the SDS and labels for all materials you work with. Know all the hazards (i.e., fire/explosion, health, chemical reactivity, and pressure) of all the materials you work with. Always use safety glasses (preferably a face shield) when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines.

Handle “empty” cylinders safely as would a full cylinder. Leave a slight positive pressure (approximately 200 psi) in them to prevent contamination of the interior of the cylinder. When the cylinder needs to be removed or is empty, close all cylinder valves, bleed remaining gas from the system (when safe to do so), disassemble equipment properly, and replace cylinder caps. Mark cylinders “empty” and store them separately from full cylinders until they are picked up by the supplier.

In the event of any emergency involving a compressed gas cylinder, evacuate the entire building immediately by sounding the fire alarm and follow the procedures for evacuation as outlined in the Chemical Hygiene Plan. Occupational Safety and Health Administration (OSHA) has additional information concerning the use of compressed gases in the workplace can be found in **regulation 29 CFR, Parts 1910.101 through 1910.105**. Information on types of high-pressure fittings that connect to gas cylinders can be found on the **Compressed Gas Association (CGA) website**.

## Reporting Requirements

- Representatives of Environmental Health and Safety are authorized to document unsafe acts, advise employee’s supervisor, and stop unsafe work from continuing.
- Supervisors may counsel or take
- other corrective action to address failure to adhere to guidelines of this program.
- Employees shall report any safety concerns to their supervisors and/or Environmental Health and Safety.

## Training

All University employees who work with compressed gases shall receive training online in the safe use of these devices. The BioRAFT training program includes but is not limited to:

- Information on the different types of compressed gas cylinders.
- How hazards are to be controlled – engineering controls, administrative controls (use of caps, restraints, regulators), personal protective equipment (PPE).
- Policies and procedures for working with compressed gas cylinders.
- Documentation of training