



## Compressed Gas Safety

**Course Number:** HS-02-101

**PDH:** 2

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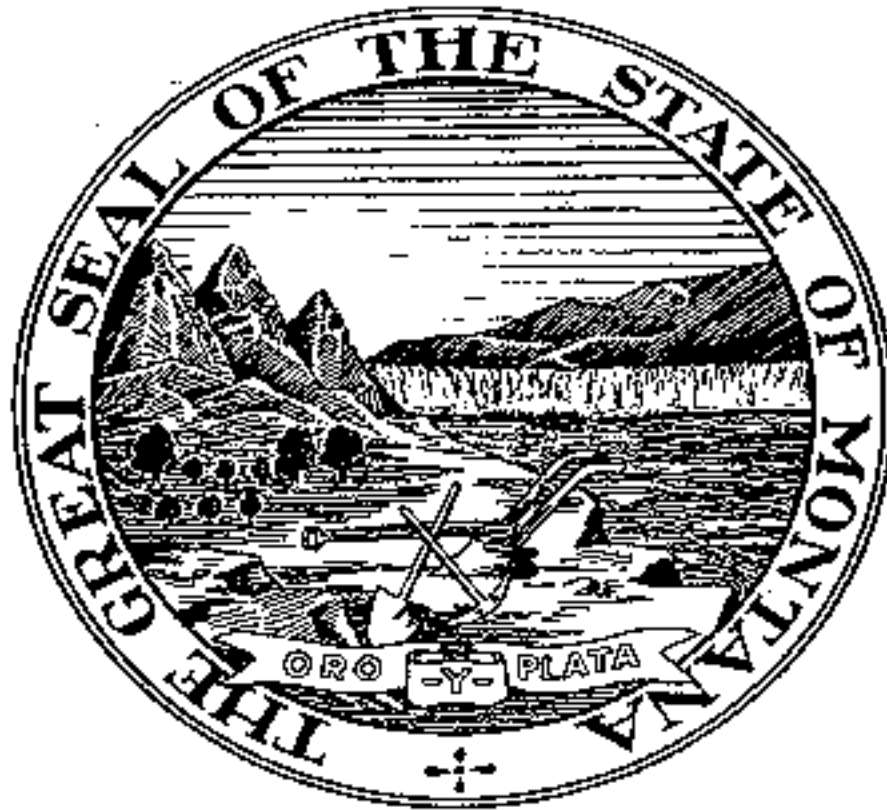
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# Compressed Gas Safety General Safety Guidelines

Occupational Safety & Health Bureau



Montana Department of Labor & Industry

Prepared for Montana Employers  
by the

Occupational Safety & Health Bureau  
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# Compressed Gas

## General



### Introduction

Compressed gas cylinders can be extremely hazardous when misused or abused. Compressed gas cylinders can present a variety of hazards due to their pressure and/or content.

Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards. Gases used maybe:

- Flammable or combustible
- Corrosive
- Explosive
- Poisonous
- Inert
- Acidic
- Reactive
- or a combination of hazards



Without proper use and care compressed gas cylinders can explode killing workers and destroying equipment. Cylinders can also become flying projectiles when cylinder valves are damaged or broken off. Regulators can become bullets that tear through workers if safety precautions are not taken.

Careful procedures are necessary for handling the various compressed gases, cylinders, regulators or valves used to control gas flow, and the piping used to confine gases during flow. This booklet can be used as a guideline for the safe use of compressed gas.

### Regulations Applicable to Compressed Gas Containers

**A. Compressed gases.** *Compressed Gas Association Pamphlet P-1-1965*, covers in-plant handling, storage, and use of all compressed gas cylinders, portable tanks, or motor vehicle cargo.

**B. Inspection of compressed gas cylinders.** Each employer must determine that compressed gas cylinders under his/her control are in a safe working condition to the extent that can be determined by a visual inspection. Visual and other inspections must be conducted as prescribed in the *Hazardous Materials Regulations of the Department of Transportation (49 CFR parts 171-179 and 14 CFR part 103)*.

Where those regulations are not applicable, visual and other inspections shall be conducted in accordance with *Compressed Gas Association Pamphlets C-6-1968 and C-8-1962*.

**C. Safety relief devices for compressed gas containers.** Compressed gas cylinders, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with *Compressed Gas Association Pamphlets (CGA) S-1.1-1963 and 1965 addenda and S-1.2-1963*.

**D. Welding and cutting.** The storage, handling, and use of compressed gas containers for welding and cutting shall comply with the *American National Standards Institute ANSI Z-49.1* and *29 CFR 1910.252*.

**E. National Fire Prevention Association.** NFPA 55, Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders.

**Checklist A** is intended to assist you in identifying possible safety and health hazards concerning compressed gas cylinders for general use. Following each check is the reference number to the *CGA Pamphlet P-1 1974* (see appendix A).

**Checklist B** is intended to assist you in identifying possible safety and health hazards concerning installation and operations of oxygen and fuel/gas systems for welding and cutting. Following each check is the reference number for *ANSI-49.1 1969* (see appendix B).

## I. Compressed Gas Safety Guidelines

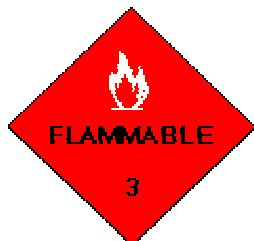
### A. Identification “ALWAYS READ THE LABEL”

The contents of any compressed gas cylinder must be clearly identified. Gas identification should be stenciled or stamped on the cylinder or a label. Commercially available three-part tag systems may be used for identification and inventory.

No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. If the labeling on a cylinder becomes unclear the cylinder should be marked “contents unknown” and returned to the supplier.

Do not rely on the color of the cylinder for identification. Color-coding is not reliable because cylinder colors may vary with supplier. Also, never rely on labels on caps because they are interchangeable.

All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas and the area served. The labels should be coded to distinguish hazardous gases such as flammable, toxic, or corrosive substances. Signs should be posted in areas where flammable compressed gases are stored or used, identifying the substance and appropriate precautions.



## **B. Handling and Use**

### **1. Before cylinders are first used the following precautions should be taken:**

- Make sure the cylinder is equipped with the correct regulator.
- Inspect the regulator and cylinder valves for grease, oil, dirt, and solvent. Never use grease or oil to lubricate regulators or cylinder valves because they can cause an explosion.
- The cylinder should be placed so that the valve handle at the top is easily accessible.
- When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- Only use wrenches or tools that are provided by the cylinder supplier to open or close a valve. Pliers should never be used to open a cylinder valve. Some regulators require washers; this should be checked before the regulator is fitted.
- Refer to MSDS for the gas being used for information regarding use and toxicity.
- Fire extinguishing equipment should be readily available when combustible materials can be exposed to welding or cutting operations using compressed cylinder gases.

### **2. Cylinder Storage**

Gas cylinders must be secured at all times to prevent tipping.

Use appropriate material, such as chain, plastic coated wire cable, commercial straps, etc., to secure cylinders.



Gas cylinders can not be stored in public hallways or other unprotected areas.

Cylinders must be segregated in hazard classes while in storage. Oxidizers (oxygen) must be separated from flammable gases, and empty cylinders must be isolated from filled cylinders.

The proper storage for oxygen cylinders requires that a minimum of 20 feet is maintained between flammable gas cylinders and oxygen cylinders or the storage area be separated, at a minimum, by a firewall five (5) feet high with a fire rating of 30 minutes.

Store out of direct sunlight and away from sources of heat and ignition; temperatures must not exceed 125 F.

Acetylene cylinders must never be stored on their sides.

Always place valve protectors on gas cylinders when the cylinders are not connected for use.

Cylinders must be protected from damage. Do not store cylinders near elevators or gangways, or in locations where heavy-moving objects may strike or fall on them.

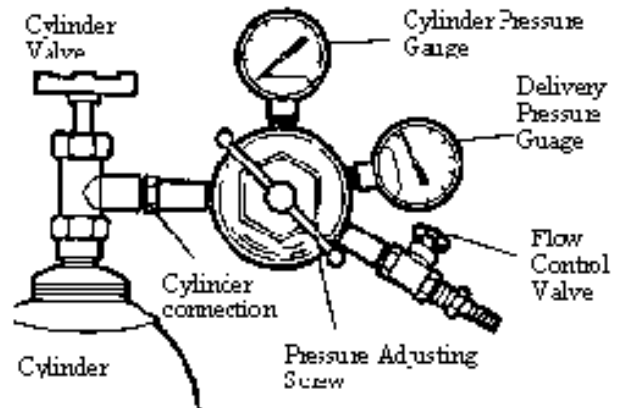
Cylinders must be stored where they are protected from the ground to prevent rusting.

Cylinders should be protected against tampering by unauthorized individuals.

Storage areas must be well-ventilated, cool, dry, and free from corrosive materials.

### 3. Moving Cylinders

- Never drag, slide or roll a cylinder; use a cylinder cart or basket.
- Always have the protective cap covering the valve when transporting the cylinder.
- Never transport the cylinder with the regulator in place.
- Make sure the cylinder is secured to the cart before moving it.
- 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. If the cylinder is dropped on a hard surface it can cause an explosion.



### 4. Use and Operation

Only properly trained personal should handle compressed gas cylinders.

Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.

Open the valve slowly and only with the proper regulator in place. Stand with the cylinder between yourself and the regulator (cylinder valve outlet facing away) when opening the cylinder valve.

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 to cut off the gas flow.

Never heat a cylinder to raise the pressure of the gas (this can defeat the safety mechanisms built in by the supplier).

Keep the cylinder clear of all electrical circuits, flame, and sparks.

Never leave the valve open when equipment is not in use, even when empty; air and moisture may diffuse through an open valve, causing contamination and corrosion within the cylinder.

Do not refill a cylinder, mixing of residual gases in a confined area may cause a dangerous reaction.



Never use copper fittings or tubing on acetylene tanks – an explosion may result.

Never use compressed gas to dust off clothing, this could cause injury to the eyes or body and create a fire hazard. Clothing can become saturated and burst into flames if touched off by an ignition source such as a spark or cigarette.

Never leave pressure in a regulator when it is not in use.

Valve protection caps should remain in place until ready to withdraw gas, or connect to a manifold.

Cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system.

Do not force connections that do not fit.

Close the cylinder valve and release all pressure before removing the regulator from the cylinder.

Do not smoke when oxygen or fuel gases are present. Smoking can cause a fire or explosion.

Do not use acetylene at operating pressures above 15 psig.

Purge fuel and oxygen hoses individually before lighting up a torch tip.

Follow the equipment manufacturer's operating instructions at all times.

If an outlet valve becomes clogged with ice, thaw it with warm water (if the gas is not water reactive), applied only to the valve.

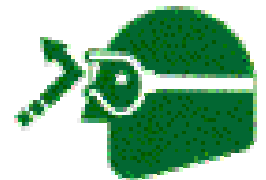
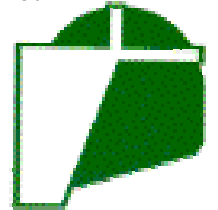
Use the cylinder valve for turning gas off, not the regulator.

Workers should wear safety glasses and face shields when handling and using compressed gases, especially when connecting and disconnecting regulators and lines.

#### OXYGEN IS NOT COMPRESSED AIR, IT IS OXYGEN

Never use oxygen as a substitute as a "compressed air" to run pneumatic tools, in oil heating burners, to start internal combustion engines, to blow out pipelines, or to create pressure for ventilation.

Oxygen cylinder valves should be opened all of the way during use.



### 5. Cylinder Leaks

- 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 a **corrosive**, remove cylinder to an isolated, well-ventilated area. The stream of leaking gas should be directed into an appropriate neutralizing material.
- For **toxic** material, the cylinder should be removed to an isolated, well-ventilated area, but only if this is possible while maintaining personal safety. It may be necessary to evacuate the facility.
- If the leak is at the junction of the cylinder valve and cylinder, do not try to repair it. Contact the supplier and ask for response instructions.
- Never use a flame to detect a gas leak. Use soapy water.



### 6. After the cylinder is no longer needed, the following steps should be taken:

Do not completely empty the cylinder; always leave some residual pressure.



If the cylinder is empty, replace the cap and remove it to the empty cylinder storage area.



Label all empty cylinders with tags so that everyone will know their status. Empty cylinders can be marked with “MT and date” with chalk.

Handle empty cylinders as carefully as full ones; residual pressure can be dangerous.

Never refill a cylinder. This requires specialized equipment and techniques.

Never mix gases in a cylinder. The next person who draws from it may unknowingly cause an explosion.

## **7. Piping for compressed air**

- Polyvinyl chloride (PVC) plastic pipes can not be used for transporting compressed gases aboveground unless they are completely enclosed in a conduit or casing of sufficient strength to provide protection from external damage and deterioration. The heat generated from compressed air can weaken the PVC pipe and create an explosion hazard. When PVC piping explodes, plastic shrapnel pieces can be thrown in all direction and injure workers or damage equipment.
- Copper piping shall not be used for acetylene.
- Do not use cast iron pipe for chlorine.
- Distribution lines and their outlets need to be clearly labeled.
- Inspect piping systems on a regular basis.
- Pay attention to fittings as well as possible cracks that may have developed.

## **8. Hoses and Connections**

Examine hoses regularly for leaks, set up an inspection schedule.

Do not use unnecessarily long hoses.

Keep hoses free from kinks and away from high traffic areas.

Repair leaks promptly and properly.

Store hoses in a cool place, and protect them from hot objects, and sparks.

Do not use a single hose having more than one gas passage.

## **II. Engineering Controls**

Listed below are some engineering controls that can be used in some cases to control the risk of compressed gas use.

1. Emergency Shutoff Switch – can be used at a remote location to cause pneumatic valves to shut, stopping gas flow. Switches should be non-electric so that arcs or sparks are not created around flammable gases.
2. Gas Cabinets – hazardous gas cylinders should be housed in a gas cylinder cabinet. These cabinets can be equipped with sprinkler protection and ventilation.
3. Flow Restrictors – can be used to limit hazardous gas flow to just over maximum flow needed, must be installed immediately downstream of each hazardous gas cylinder.
4. Emergency Eyewash – must be present in areas where corrosive materials or gas is used.

### **Resources**

Listed below are a few resources that can be used to find safety and health information and standards.

**National Institute for Occupational Safety and Health, (NIOSH)** Department of Health and Human Services,  
200 Independence Ave. SW 317B,  
Washington, DC 20201.  
Phone: 1-800-356-4674, 1-800-35-NIOSH  
Web site: [www.niosh.gov](http://www.niosh.gov)

U.S. Department of Labor, **Occupational Safety & Health Administration, (OSHA).**  
Public Affairs Office -Room 3647,  
200 Constitution Ave,  
Washington, D.C. 20210.  
Phone: (202) 693-1999  
Web site: [www.osha.gov](http://www.osha.gov)

**Compressed Gas Association (CGA)**  
1725 Jefferson Davis Highway  
Suite 1004  
Arlington, VA 22202-4102  
Phone: (703) 412-0900  
Fax: (703) 412-0128  
Web site: [www.cganet.com](http://www.cganet.com)

Appendix A.

**Compressed Gas Safety Checklist (A) General Use**

- \_\_\_\_\_ Are containers/cylinders labeled properly? (3.1.3)
- \_\_\_\_\_ Pressure Relief Device present and free from damage? (3.2.4)
- \_\_\_\_\_ Container free of corrosion and other recognized damage? (3.2.10-3.2.11)
- \_\_\_\_\_ Valve protection caps in place and at least hand tight? (3.3.2)
- \_\_\_\_\_ Containers are not used as rollers, supports, or other unintended purposes? (3.3.3)
- \_\_\_\_\_ Are empty cylinders marked as such and valves closed? (3.3.4)
- \_\_\_\_\_ Cylinders are not placed where they may become part of an electrical circuit? (3.3.5)
- \_\_\_\_\_ Cylinders are not exposed to temperatures greater than 125 F? (3.3.6)
- \_\_\_\_\_ Are cylinders Leaking? (3.3.8)
  - \_\_\_\_\_ Tighten valve
  - \_\_\_\_\_ Close valve
  - \_\_\_\_\_ Tag Unserviceable
  - \_\_\_\_\_ Toxic? Provide proper respirator protection
  - \_\_\_\_\_ Keep away from flames
  - \_\_\_\_\_ Take outdoors or place in exhaust system
  - \_\_\_\_\_ Place warning tag on cylinder
  - \_\_\_\_\_ Notify supplier
- \_\_\_\_\_ Valve caps are not used to lift cylinders. (3.4.3.1)
- \_\_\_\_\_ Ropes, slings, or chains are not used to suspend cylinders without appropriate lifting attachments? (3.4.3.3)
- \_\_\_\_\_ Storage (3.5)
  - \_\_\_\_\_ Grouped by types and labeled with name of gas
  - \_\_\_\_\_ Full and empty containers separate and stored upright
  - \_\_\_\_\_ Storage rooms dry and well ventilated
  - \_\_\_\_\_ Not stored near salts, corrosive chemicals or fumes, dampness
  - \_\_\_\_\_ Protected from damage by other material
  - \_\_\_\_\_ Stored away from walkways, gangplanks, aisles, doors, exits, etc.
  - \_\_\_\_\_ Outside storage chemicals protected from bottom corrosion
- \_\_\_\_\_ Employees trained on handling and use of cylinders? (3.6.1)
- \_\_\_\_\_ Containers are secured to prevent them from being knocked over? (3.6.4)
- \_\_\_\_\_ Compressed gasses are not used to dust off clothing? (3.6.11)

## Additional Precautions for Specific Gases

### Flammable Gases (4.1)

- \_\_\_\_\_ Adequate fire extinguishers near storage areas
- \_\_\_\_\_ No Smoking signs posted near storage

### Oxygen (4.2)

- \_\_\_\_\_ Containers, valves, regulators, hose, and other apparatus free from oil and grease
- \_\_\_\_\_ Stored 20 feet from combustibles or separated by a wall at least 5 foot high and made of non-combustible material with at least a 30 minute fire rating
- \_\_\_\_\_ Ambient air oxygen content not greater than 23 percent except hyperbaric chambers

### Acid and Alkaline Gases (4.3)

- \_\_\_\_\_ Proper Personal Protective Equipment – Goggles, faceshields, gloves, aprons, long sleeve shirts, trousers. No open shoes or sneakers.
- \_\_\_\_\_ Proper Respiratory protection available
- \_\_\_\_\_ Eyewash stations and showers

#### Some Common Acid and Alkaline Gases

Ammonia	Sulfur Dioxide	Ethyl amine
Boron	Trifluoride	Methyl amine
Hydrogen Chloride	Chlorine	Trimethyl amine
Hydrogen Bromide	Hydrogen Sulfide	Nitrosyl Chloride
Fluorine	Dimethyl amine	

### Highly Toxic Gases (4.4)

- \_\_\_\_\_ Proper respiratory protection available
- \_\_\_\_\_ Store outside or in separate, noncombustible building, without other occupancy
- \_\_\_\_\_ Used in forced ventilation
- \_\_\_\_\_ Employees trained on proper use and handling

#### Some Common Highly Toxic Gases

Carbonyl Fluoride	Chlorine	Phosphine
Fluorine	Germane	Hydrogen Cyanide
Hydrogen Selenide	Nitric Oxide	Nickel Carbonyl (liquid)
Nitrogen Dioxide	Ozone	Phosgene

Appendix B

**Compressed Gas Safety Checklist (B) Welding & Cutting**

- \_\_\_\_\_ Mixtures of fuel and air or oxygen guarded against? (3.1.1)
- \_\_\_\_\_ Acetylene used <15 psi <30 psi absolute pressure? (3.1.2)
- \_\_\_\_\_ Only approved apparatus used? (3.1.3)
- \_\_\_\_\_ Employees trained on handling and use? (3.1.4)
- \_\_\_\_\_ Cylinders labeled properly? (3.2.2)
- \_\_\_\_\_ Storage (3.2)
  - \_\_\_\_\_ Kept away from heat and flame
  - \_\_\_\_\_ Empty cylinders valves closed
  - \_\_\_\_\_ Valve protection caps in place and hand tight
  - \_\_\_\_\_ Greater than 20 feet from combustibles
  - \_\_\_\_\_ Ventilation
  - \_\_\_\_\_ Protected from damage
- \_\_\_\_\_ Oxygen cylinders, valves, regulators, hose and apparatus free of oil and grease?  
(3.2.4)
- \_\_\_\_\_ Cylinder valves open and closed by hand? (3.2.5)
- \_\_\_\_\_ When parallel lengths of oxygen and acetylene hose are taped together, not more than  
4 inches out of 12 inches shall be cover with tape (3.5.5)
- \_\_\_\_\_ Proper pressure reducing regulators used for gas and pressures for which they are  
intended? (3.5.6)

Review Information
Name of University/ Community / Technical College:
Date of inspection:
Signature of inspector:



**Minnesota**  
STATE COLLEGES  
& UNIVERSITIES

## Compressed Gases Cylinders Self-Inspection Checklist

**Guidelines:** This checklist covers regulations issued by the U.S. Department of Labor, OSHA under the General Industry standard 29 CFR 1910.101. It applies to the handling, storage, and use of compressed gases in cylinders or portable tanks.

The Compressed Gas Association's (CGA) Pamphlets C-6-1986, C-8-1962, and P-1-1965 are adopted by OSHA standard by reference. The following questions relate to the more common precautions to be taken in educational environments. The Compressed Gas Association has updated the three pamphlets cited by OSHA as C-6-1993, C-8-1997, and P-1-1999.

	<b>Please Underline</b>
1. Are periodic inspections of compressed gas storage and usage areas performed and deficiencies corrected?	Y N N/A ??
2. Are work areas maintained in clean and orderly condition?	Y N N/A ??
3. Are Material Safety Data Sheets available for all compressed gases used?	Y N N/A ??
4. Are cylinders stored in upright positions and immobilized by chains or other means to prevent them from being knocked over? [CGA 3.4.4 and 29 CFR 1910.101(b)]	Y N N/A ??

Cylinders are very heavy, can tip easily and they have inherent hazards of high pressure. Tragic accidents have occurred when a cylinder was knocked over, damaging the cylinder and turning it into a rocket. Gas cylinders may be under very high pressure (e.g. Carbon dioxide and carbon monoxide can be 1,000 psi; argon, helium, hydrogen, nitrogen, oxygen can be 2,600 psi). Secure cylinder and fittings whether full or empty upright by straps, chains or stands connected to a wall bracket or other fixed surface, or by use of a cylinder stand to prevent them from falling.

**2.** Are cylinders stored away from highly flammable substances such as oil, gasoline, or waste?  
[CGA 3.3.6]

**Y N N/A ??**

Store cylinders in a dry well ventilated area away from heat and ignition sources. Keep cylinders at least 20 ft from flammable materials such as paint, oil or solvents.

**3.** Are cylinders stored away from electrical connections, gas flames or other sources of ignition, and substances such as flammable solvents and combustible waste material?  
[CGA 3.5.1]

**Y N N/A ??**

Cylinders are not designed for temperatures above 130 F.

**4.** Are flammable gases separated from oxidizing gases in storage areas?  
[CGA 3.3.3]

**Y N N/A ??**

Acetylene and propane cylinders should be separated from oxygen cylinders when not in use.

**5.** Are oxygen and fuel gas cylinders separated by a minimum of 20 feet when in storage?  
[CGA 3.5.3]

**Y N N/A ??**

The cylinders could be separated by 5 ft high wall with half-hour fire resistance rating.

**6.** Are storage rooms for cylinders dry, cool and well-ventilated?  
[CGA 3.3.5]

**Y N N/A ??**

The storage rooms should be fire resistant and the storage should not be in subsurface locations. Cylinders should be stored in secure areas at temperatures below 125°F, away from radiators or other sources of heat. Cylinders should never be stored in unventilated lockers or closets.

**7.** Are cylinders stored away from incompatibles, excessive heat, continuous dampness, salt or other corrosive chemicals, and any areas that may subject them to damage?  
[CGA 3.3.7 and 29 CFR 1910.101(b)]

**Y N N/A ??**

Rusting will damage the cylinder and may cause the valve protection cap to stick. Keep all cylinders and fittings where they cannot be contaminated by oil or grease. Protect cylinders from extremes of weather, such as ice, snow and direct sunlight.

<p><b>8.</b> Is the storage area permanently posted with the names of the gases stored in the cylinders? [CGA 3.3.2 and 29 CFR 1910.101(b)]</p>	<p><b>Y N N/A ??</b></p>
<p>Ensure that 'No Smoking' Signs are posted and enforce rules. Recommended to have separate storage areas for the cylinders according to their contents: Flammable, oxidizing and/ or inert gases.</p>	
<p><b>9.</b> Do all compressed gas cylinders have their contents and precautionary labeling clearly marked on their exteriors? [29 CFR 1910.101(b)]</p>	<p><b>Y N N/A ??</b></p>
<p>All compressed gas cylinders have to be legibly marked to identify the gas contained. There are specific hazards of certain compressed gases:</p> <ul style="list-style-type: none"> <li>• Toxic gases (e.g. Carbon monoxide, hydrogen cyanide, nitric oxide, phosgene)</li> <li>• Corrosive gases (e.g. ammonia, chlorine, nitrogen dioxide, nitric oxide, sulfur dioxide, etc.)</li> <li>• Flammable gases (e.g. acetylene, ammonia, ethylene, etc.)</li> <li>• Explosive (e.g. Hydrogen, etc.)</li> <li>• Oxidizers (e.g. Fluorine, oxygen, etc.)</li> <li>• Simple asphyxiates (e.g. Carbon dioxide, helium, nitrogen, sulfur hexafluoride)</li> </ul>	
<p><b>10.</b> Are all compressed gas cylinder valve covers in place when cylinders are not in use? [29 CFR 1910.101(b)]</p>	<p><b>Y N N/A ??</b></p>
<p><b>11.</b> Are all compressed gas cylinders stored so they do not interfere with exit paths? [29 CFR 1910.101(b)]</p>	<p><b>Y N N/A ??</b></p>
<p>Store cylinders away from elevators, stairs, doorways and aisles.</p>	
<p><b>12.</b> Are all compressed gas cylinders subjected to periodic hydrostatic testing and interior inspection? [29 CFR 1910.101(a)]</p>	<p><b>Y N N/A ??</b></p>
<p>This is normally done by the supplier.</p>	
<p><b>13.</b> Do all compressed gas cylinders have safety pressure relief valves? [29 CFR 1910.101(c)]</p>	<p><b>Y N N/A ??</b></p>
<p><b>14.</b> Are cylinders always maintained at temperatures below 125°F? [CGA 3.1.12]</p>	<p><b>Y N N/A ??</b></p>
<p>A flame should never come in contact with any part of a compressed gas cylinder. Also do not store cylinders where temperature can drop to below freezing as this can cause the cylinder metal to become brittle resulting in metal fatigue and failure.</p>	
<p><b>15.</b> Are safety relief devices in the valve or on the cylinder free from any indication of tampering? [CGA 3.1.14]</p>	<p><b>Y N N/A ??</b></p>



Ensure that there is no tampering with the safety relief device in the valve or cylinder or any attempt to repair or alter the cylinder, valve or safety relief device.	
<b>16.</b> Is repair or alteration to the cylinder, valve, or safety relief devices prohibited? [CGA 3.1.15]	<b>Y N N/A ??</b>
All alterations and repairs to the cylinder and valve must be made by the compressed gas vendor. Modification of safety relief devices beyond the tank or regulator should only be made by a competent person appointed by management.	
<b>17.</b> Is painting cylinders without authorization by the owner prohibited? [CGA 3.1.20]	<b>Y N N/A ??</b>
Often color codes are used to help designate cylinders. Arbitrary paint is not recommended.	
<b>18.</b> Are charged or full cylinders labeled and stored away from empty cylinders? [CGA 3.3.4 and 29 CFR 1910.101(b)]	<b>Y N N/A ??</b>
Keep full and empty cylinders apart to prevent accidental part-filling of an empty cylinder by back-feeding.	
<b>19.</b> Is the bottom of the cylinder protected from the ground to prevent rusting? [CGA 3.3.9]	<b>Y N N/A ??</b>
<b>20.</b> Are all compressed gas cylinders regularly inspected for corrosion, pitting, cuts, gouges, digs, bulges, neck defects and general distortion? [29 CFR 1910.101(a)]	<b>Y N N/A ??</b>
<b>21.</b> Are cylinder valves closed at all times, except when the valve is in use? [CGA 3.1.15]	<b>Y N N/A ??</b>
Regulator diaphragms have failed, and unwanted gas was delivered to an area or apparatus, causing safety and health problems. Close valves of empty cylinders. Fit protection caps.	
<b>22.</b> Are compressed gas cylinders always moved, even short distances, by a suitable hand truck? [CGA 3.2.6]	<b>Y N N/A ??</b>
They must never be dragged across the floor. Serious accidents have occurred when a cylinder with a regulator in place was improperly moved. The cylinder fell, causing the regulator to shear off, and the cylinder rocketed through several brick walls. To move a compressed gas cylinder, it should be secured to cylinder truck or cart. Regulators should be removed and valve protection caps should be secured in place before moving cylinders. Also, cylinder valves should be closed before moving the cylinders.	
<b>23.</b> Is using wrenches or other tools for opening and closing valves prohibited? [CGA 3.4.9]	<b>Y N N/A ??</b>
Hammering on valve wheels to open them should be strictly prohibited. For valves that are hard to open,	

contact the supplier for instruction.	
24. Are suitable pressure regulating devices in use whenever the gas is emitted to systems with pressure-rated limitations lower than the cylinder pressure? [CGA 3.4.5]	Y N N/A ??
25. Are all compressed gas cylinder connections such as pressure regulators, manifolds, hoses, gauges, and relief valves checked for integrity and tightness? Are compressed gas cylinders visually inspected? [29 CFR 1910.101(a)]	Y N N/A ??
26. Are all compressed gas cylinders regularly subjected to leak detection using an approved leak detecting liquid? [29 CFR 1910.101(a)]	Y N N/A ??
Ordinary soap solution may contain oils that are unsafe when used with oxygen cylinders. Leak detection liquids are available from commercial welding supply houses.	
27. Is an approved leak-detection liquid used to detect flammable gas leaks? [CGA 3.5.2]	Y N N/A ??
A flame should <b>never</b> be used.	
28. Are procedures established for when a compressed gas cylinder leak cannot be remedied by simply tightening the valve? [CGA 3.1.6]	Y N N/A ??
The procedures should include the following: <b>a.</b> Attach tag to the cylinder stating it is unserviceable. <b>b.</b> Remove cylinder to a well ventilated out of doors location. <b>c.</b> If the gas is flammable or toxic, place an appropriate sign at the cylinder warning of these hazards. <b>d.</b> Notify the gas supplier and follow his/her instructions as to the return of the cylinder.	
28. Are students/employees prohibited from using compressed gases (air) to clean clothing or work surfaces? [29 CFR 1910.101(b)]	Y N N/A ??
Cleaning machinery, bench tops, clothing, objects and other things with compressed air is dangerous. Depending on its pressure, compressed air can dislodge particles. These particles are danger since they can enter eyes or abrade skin. The possible damage would depend on the size, weight, shape, composition and the speed of the particles. Compressed air is serious hazard. There is likelihood that compressed air can enter the bloodstream through a break in the skin or through a body opening. An air bubble in the blood stream is dangerous medical condition in which the blood vessel is blocked and can cause coma, paralysis or death depending upon its size, duration and location.	
29. Are compressed gases only handled by experienced and properly trained people? [CGA 3.4.1]	Y N N/A ??

Training must include safe usage procedures, employee protection from potential health and physical hazards associated with gas and cylinder usage, personal protective equipment and specific information relevant to the gas being used.

**30.** Are fire extinguishing equipment readily available when combustible materials could be exposed to welding or cutting operations using compressed cylinder gases?

**Y N N/A ??**

**31.** Are laboratory storage of compressed gas cylinders limited only those in use?

**Y N N/A ??**

Use cylinders in rotation as received from the supplier. Plan storage layout so that old stock can be removed first with little handling of other cylinders.

**References:**

*Handbook of Compressed Gases*, Compressed Gas Association, Arlington, VA, latest edition.

NIOSH Safety Checklist Program for Schools.

**Comments/Corrective action:**

# Handling, storage, and use of compressed gas cylinders

Air Products would like to ensure the safe handling of our products. As our customer, you need to share in the responsibility for safe handling, storage, and use of our products.

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## Follow these seven general safety recommendations:

1. Know and understand the properties, uses, and safety precautions before using any gas or gas mixture. Consult the Air Products Safety Data Sheet (SDS) and Safetygrams for safety information on the gases and equipment you will be using.
2. Determine the appropriate equipment required to use the product and know how to safely operate the equipment.
3. Be aware of potential hazards and develop plans to cover possible emergencies. Use emergency drills to practice implementing these plans. Inform local hospitals, fire departments, and other emergency response organizations of the gases in use so that they, too, will be prepared in the event of an emergency.
4. Provide personal protective equipment (PPE) and the required training for its use. Require personnel to wear the proper PPE for each task. Locate other safety equipment such as fire extinguishers, eye wash stations, and showers at appropriate locations. Thoroughly inform everyone about the hazards of the gases they are using and how to respond to an emergency.
5. Follow all national, state, and local regulations pertaining to the storage, use, and disposal of compressed gases and cryogenic liquids. This document highlights the recommendations set forth in ISO Standard 11625, "Gas Cylinders—Safe Handling." In the United States, this document is published by the Compressed Gas Association as Pamphlet P-1, "Safe Handling of Compressed Gases in Containers," and has been incorporated into the regulations, making the contents of the document legal requirements in the United States, not recommendations. Other regional organizations such as the Asian Industrial Gases Association (AIGA),

the European Industrial Gases Association (EIGA), and the National Fire Protection Association (NFPA) also provide guidance for the storage and use of compressed gas cylinders.

6. If you are unfamiliar with the hazards associated with a particular gas, contact your supplier for additional information.
7. Use appropriate equipment when handling portable cylinder banks. They have a high center of gravity, and extreme care must be taken during their movement. Portable banks may fall over when being moved if they are stopped suddenly by an object or crack in the floor.

## Handling

Compressed gas cylinders should be handled only by those familiar with the hazards and who are trained in the proper handling techniques. Cylinders containing compressed gases are heavy and awkward to move. Improper handling of compressed gas cylinders can result in sprains, strains, falls, bruises, or broken bones. Other hazards such as fire, explosion, chemical burns, poisoning, and cold burns could occur if gases accidentally escape from the cylinder due to mishandling. Take the following precautions to prevent injuries caused by the improper handling of compressed gas cylinders.

### NEVER

- Drag or slide cylinders, even for short distances.
- Drop cylinders or permit them to strike each other violently.
- Subject cylinders to mechanical shocks that may cause damage to their valves.
- Use cylinders as rollers for moving material or other equipment.
- Tamper with pressure-relief devices.
- Permit oil, grease, or other readily combustible substances to come in contact with cylinders, valves, or other equipment in oxidizer service.
- Remove any product labels or shipping hazard labels.
- Refill compressed gas cylinders. This is to be done only by qualified producers of compressed gases.
- Lift a cylinder by its cap using a sling or a magnet.
- Attempt to catch a falling cylinder.

### ALWAYS

- Move cylinders using a suitable hand truck or cart. (refer to figure 1)
- Leave the valve protection cap and valve seal outlet in place until the cylinder has been secured in place and is ready to be used.
- Secure cylinders when in storage, transit, or use.
- When returning cylinders to the supplier, properly close the cylinder valve, replace and secure any valve outlet seals, and properly install the cylinder cap.
- Use a cylinder cage or cradle to lift a cylinder.

- Use the proper PPE for cylinder handling. Wear safety glasses with sideshields, leather gloves, safety shoes, and other appropriate equipment.
- Use extreme care and restrict the movement of portable banks to localize movement on clean, smooth, level stationary surfaces.
- Use two people for localized manual movement of a portable bank. Stay out of the bank's travel path. Also, be aware of escape routes should the bank get out of control or start falling. If a smooth, level surface is not available over which to move the portable bank, use a forklift, crane, or other appropriate moving equipment.

Figure 1: Typical Cylinder Hand Trucks



## Storage

Take the following precautions to prevent injuries caused by asphyxiation, fire, explosion, high pressure, and improper handling of compressed gas cylinders.

### NEVER

- Allow storage temperature to exceed 125°F (52°C).
- Permit smoking or open flames in oxidizer or flammable gas storage areas.
- Expose cylinders to corrosive materials such as ice melting compounds.

### ALWAYS

- Store cylinders in accordance with ISO Standard 11625 or CGA Pamphlet P-1.
- Store cylinders upright with valve outlet seals and valve protection caps in place. See Air Products' Safetygram-14, "Don't Turn a Cylinder Into a Rocket."
- Secure cylinders when in storage, transit, or use.
- Store cylinders in areas designated for that purpose.
- Segregate full and empty cylinders.
- Store cylinders in a dry, cool, well-ventilated, secure area protected from the weather and away from combustible materials.
- Ensure that there is adequate separation from combustibles as specified by national regulations.
- Monitor the atmosphere in areas where gases may vent and collect.
- Use a first-in, first-out (FIFO) inventory system to prevent full containers from being stored for long periods of time.

- Store only the amount of compressed gas required for the specific application.
- Store cylinders away from heavily traveled areas and emergency exits.
- Provide adequate access for cylinder handling.
- Visually inspect stored cylinders on a routine basis, or at least weekly, for any indication of leakage or problems.
- Restrict access to cylinder storage areas.
- Protect cylinders from wet or damp ground.

## Proper use of compressed gases

Take the following precautions to prevent injuries caused by the improper use of compressed gases.

### NEVER

- Attempt to mix gases in a cylinder.
- Insert an object (e.g., wrench, screw driver, etc.) into valve cap openings to remove a stuck cylinder cap. Doing so may damage or open the valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps.
- Allow any part of a cylinder to be exposed to temperatures exceeding 125°F (52°C).
- Permit cylinders to become part of an electrical circuit.
- Use oxygen as a substitute for compressed air.
- Strike an arc on a cylinder.
- Return product into a cylinder.
- Introduce another product into a cylinder.

**Figure 2: The Correct Way to Safely Check a System**



- Use cylinder color as a primary means to identify the contents of a cylinder.
- Heat a cylinder to increase its pressure or withdrawal rate unless using an approved method. See Air Products' Safetygram-30, "Handling of Liquefied Compressed Gases."
- Discharge the contents from any gas cylinder directly toward any person.
- Refill any nonrefillable cylinder after use of the original contents.
- Force cylinder valve connections that do not fit.
- Reduce the residual pressure of a cylinder below the operating pressure of the system or 7 psig (0.5 bar), whichever is higher.
- Change service of equipment from the particular gas or group of gases for which they were intended.
- Use a mechanical adapter to connect to the cylinder valve.

## ALWAYS

- Know and understand the gases and associated equipment you will be using. Refer to the supplier's MSDS to determine the proper PPE and any other special requirements for the gas being used.
- Secure cylinders when in storage, transit, or use.
- Use a pressure-reducing regulator or separate control valve to safely discharge gas from a cylinder.
- Use regulators approved for the specific gas.
- Leak-test lines and equipment with an inert gas before using.
- Use regulators and pressure-relief devices when connecting cylinders to piping circuits with lower pressure service ratings.
- Use check valves to prevent reverse flow into the cylinder.
- Loosen the valve outlet seal slowly when preparing to connect a cylinder.
- Open cylinder valves slowly and carefully after the cylinder has been connected to the process.
- Stand clear of the regulator and valve outlet while opening the valve.
- Prevent sparks and flames from contacting cylinders.

- Discontinue use and contact the supplier if a cylinder valve is difficult to operate. Wrenches should not be used on valves equipped with handwheels. If the valve is faulty, tag the cylinder, identifying the problem, and notify the supplier.
- Close the cylinder valve and release all pressure from the downstream equipment connected to the cylinder anytime an extended non-use period is anticipated.
- Use oxygen-compatible threading compounds, such as Teflon® tape on systems for use in oxygen or oxidizer service.
- Remember, the cylinder label or decal is the only positive way to identify the contents of a cylinder.

More information on gas handling is provided in Air Products' Safetygram-12, "Regulator Selection, Installation, and Operation."

## Emergency Response System

T 800-523-9374  
(Continental U.S. and Puerto Rico)  
T +1-610-481-7711 (other locations)  
For regional ER telephone numbers, please refer to the local SDS 24 hours a day, 7 days a week for assistance involving Air Products and Chemicals, Inc. products

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## Technical Information Center

T 800-752-1597 (U.S.)  
T +1-610-481-8565 (other locations)  
Monday–Friday, 8:00 a.m.–5:00 p.m. EST  
F 610-481-8690  
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## For more information, please contact us at:

### Corporate Headquarters

Air Products and Chemicals, Inc.  
7201 Hamilton Boulevard  
Allentown, PA 18195-1501

For regional contact information, refer to the local SDS or contact your local sales representative.



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