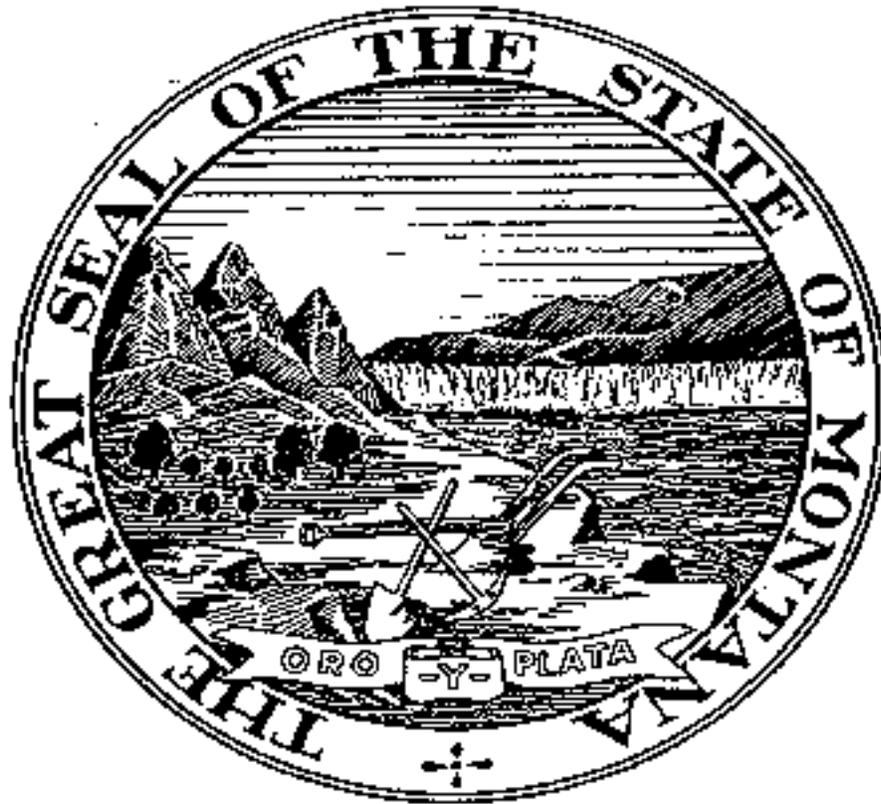


Compressed Gas Safety General Safety Guidelines

Occupational Safety & Health Bureau



Montana Department of Labor & Industry

Prepared for Montana Employers
by the

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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.

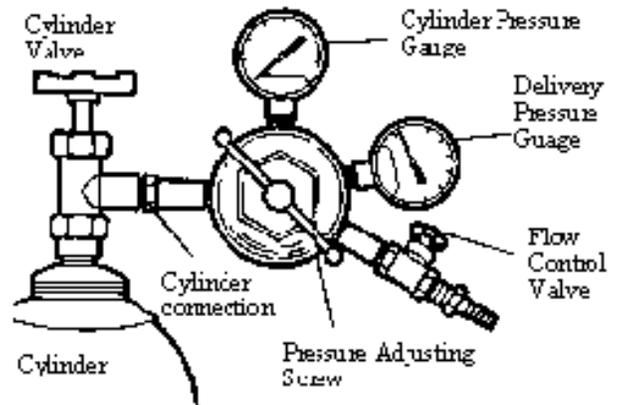
Cylinders must be stored where they are protected from the ground to prevent rusting.

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.

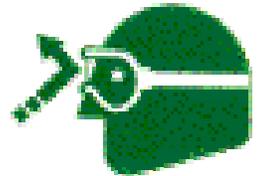
Use the cylinder valve for turning gas off, not the regulator.

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

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

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

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)