

## Chapter 5

### Compressed Gas Cylinders

#### A. References

1. [WAC 296-24 Part K Compressed Gas and Compressed Gas Equipment](#)
2. [WAC 296-24 Part E Hazardous Materials, Flammable and Combustible Liquids, Spray Finishing](#)
3. Compressed Gas Association "CGA P-1: Safe Handling of Compressed Gases."
4. International Fire Code (IFC) Section 3004: Storage of Compressed Gases
5. IFC Section 3005: Use and Handling of Compressed Gases
6. [Washington Department of Health Publication "DOH 331-364: How to Handle Chlorine Gas Safely" May 2010.](#)

#### B. Scope

College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) personnel working with or around compressed gas cylinders shall know and comply with this chapter's requirements and the rules, policies, and procedures referenced above. This chapter includes subsections that reference the following:

- A. Responsibilities
- B. Entering Laboratories and Shops with Compressed Gas Cylinders
- C. Training
- D. Guidelines for Compressed Gas Cylinders – Use
- E. Guidelines for Compressed Gas Cylinders – Storage
- F. Guidelines for Compressed Gas Cylinders – Transport
- G. Guidelines for Compressed Gas Cylinders – Emergencies

#### C. Responsibilities

##### 1. **Supervisor Responsibilities:**

- Ensure compressed gas cylinders are inspected, used, and stored per this chapter's requirements, State rules, and International Fire Code.
- Ensure that damaged cylinders are immediately returned to the supplier.
- Ensure inventory and safety data sheets (SDS) are kept for all gas cylinders in their area.
- Ensure employees use appropriate personal protective equipment (PPE) when working with or around compressed gases.
- Ensure an incident response plan is in place for responding to an emergency involving compressed gasses and cylinders.
- Ensure personnel under their supervision (employees, paid and unpaid students) receive the necessary training. Training shall include general safety guidelines for working with compressed gasses and gas cylinders and gas-specific (e.g., flammable, toxic, etc.) hazards.

**2. Employee Responsibilities:**

- Shall inspect, use and store compressed gas cylinders per this chapter's requirements, state rules, and International Fire Code.
- Shall not use gas cylinders if damaged and shall notify their supervisor of damaged gas cylinders and arrange for an immediate return to the supplier.
- Shall confirm the identity of the gas before using it by reading the label or other markings on the cylinder. If cylinder contents cannot be identified through the tag or markings, return the cylinder to the supplier without using it.
- Shall not modify, tamper with, paint, obstruct, remove or repair any part of the cylinder, including the pressure relief device and the container valve or the valve protection device. It is illegal to remove or change the prescribed numbers or marks stamped into cylinders.
- Shall use appropriate PPE as required by department/supervisor.
- Shall participate in required training before using any compressed gasses.

**D. Training**

WSU personnel working with or around compressed gases shall be trained at the time of hire in general compressed gas and compressed gas cylinder safety principles, including site-specific safety procedures and gas-specific hazards. Training will require participants to demonstrate an understanding of the topic and proficiency in using the equipment. Re-training will be necessary when:

- There have been changes in the workplace, such as new processes and equipment, which render previous training obsolete;
- Changes in the types of equipment that render the previous training obsolete;
- When an employee exhibits inadequate knowledge, skill, and understanding or non-conforming use of the equipment.

**E. Guidelines for Compressed Gas Cylinders – Use**

1. Cylinders shall always be secured upright to protect against falling or rolling. Valves must be closed at all times when gas is not in use. Removable valve protection caps must be fully threaded onto gas cylinders when regulators are not attached.
2. Cylinders (full and empty) must be anchored to a wall or bench clamp or secured within cylinder racks or stands. An appropriate restraint device (strap or chain) shall always be used.
3. Cylinders shall be used in a secured area that is cool, dry, and well ventilated and shall not be exposed to excessive dampness, salt, corrosive chemicals, or fumes.
4. Gases shall not be transferred from one compressed gas cylinder to another. Do not attempt to refill gas cylinders.
5. Perform regular visual inspections of compressed gas cylinders for leaks, cracks, and deformities. Always ensure that all connections are leak-tight. Each time connections are loosened and retightened, each link should be checked with a soap

and water solution (oil-free soap). Do not check with flame. If a cylinder is ever thought to be defective, it should be removed from service and returned to the supplier for replacement.

6. All compressed gases must be used on the cylinder or manifold through a pressure regulating device. Always use a regulator to reduce gas cylinder pressure to the operating pressures recommended by the equipment manufacturer. All piping and equipment must meet the standards of the Compressed Gas Association.
7. Never use regulators, gauges, hoses, and other appliances for gases with different chemical properties other than those the manufacturer designed unless the manufacturer or supplier provides information indicating that this can be done safely.
8. Never force connections that do not fit. Threads on regulator connections or other auxiliary equipment must be similar to those on the cylinder valve outlet.
9. Keep cylinders, valves, and fittings clean. Never apply sealants (liquid or tape form) or lubricants to cylinder valves or connection fittings. Do not use PTFE tape. Never let oil or grease contact your cylinder or its valve and fittings, especially oxygen cylinders.
10. Oxygen regulators must be marked "Use No Oil." Regulators and fittings must meet the specifications of the Compressed Gas Association.
11. Install flashback arrestors on the fuel gas and oxygen cylinder regulators.
12. Never attempt to adapt and use a fuel gas or inert gas regulator on an oxygen cylinder. A particular protective device is incorporated into the oxygen regulator to dissipate the heat caused by the recompression when the cylinder valve is quickly opened. Such a protective device is not furnished on fuel gas and inert gas regulators.
13. Never partially open the cylinder valve ("cracking" cylinder) to remove dust, dirt, or debris from the cylinder inlet.
14. Before attaching a regulator to a gas cylinder, ensure the regulator adjusting screw is fully released (backed off in a counterclockwise direction). There can be no flow through the regulator when the initially opened cylinder valve is open. Never stand in front of a regulator when opening a cylinder valve.
15. Always open the cylinder valve slowly so that gas pressure will build up slowly in the regulator (particularly in an oxygen cylinder). Quick opening of the cylinder valve causes a buildup of heat due to recompression of the gas. When combined with combustible materials, ignition and explosion may result. Never use force when opening or closing valves.
16. When in use, cylinder valves used in the fully open position may become stuck in this open position. To prevent this, ensure that the handwheel or cylinder valve key is turned back half a turn.
17. Before removing a regulator, close the cylinder valve and release the remaining pressure from the regulator. Removing regulator fittings under pressure may result in serious personal injury as fittings may be ejected at high velocity.
18. Never tamper with the safety devices on cylinders (fuse plugs, safety discs, etc.)

and do not permit torch flames or sparks to strike the cylinder.

19. Always refer to the various gases by their proper names. (Do not refer to oxygen as “air” or acetylene as “gas.”)
20. Never attempt to mix gases in a cylinder or fill an empty one from another (particularly oxygen cylinders). A mixture of incompatible gasses and heat caused by recompression of the gas or gasses may result in ignition and fire.
21. Never use oxygen or other gases as a substitute for compressed air in operating air-operated tools, blowing off parts, or for ventilation purposes. The only exception to this rule is where oxygen is used to blow out port passages and talcum powder or dust from welding hoses when setting up new or old “dusty” equipment.
22. Defective hoses must permanently be removed from service. Never repair hoses with tape. Gas hoses must meet the specifications of the Compressed Gas Association.
23. Never use wrenches or tools except those provided or approved by the gas manufacturer. Avoid using a wrench on valves equipped with handwheels. Do not hammer on any cylinder, especially the valve wheel, in an attempt to open or close the valve. Do not tamper with the relief valves. If you have trouble, contact the supplier for assistance.
24. Never use a hammer on the valve protection caps to loosen them. If necessary, use a piece of wood to soften the impact and prevent sparks and damage to the lid. If you have trouble, contact the supplier for assistance.
25. Never use cylinders as rollers to move other material or as supports or for any purpose other than to contain their contents as received. Do not let cylinders bump into each other or let them fall.
26. Do not place cylinders where they can become part of an electric circuit or might be burned by an electric welding arc. Please do not use them as ground during electric welding.
27. Always follow the manufacturer’s recommendations for setting up and operating equipment, including gas cylinder operating pressures. When in doubt about the proper handling of a compressed gas cylinder or its contents, consult the manufacturer or supplier of the gas.
28. Repair work on cylinders, cylinder valves, gauges, and regulators must be done by qualified personnel.
29. Wear appropriate PPE when working with compressed gases.

### Acetylene Use Guidelines

- Never use acetylene over 15 psi pressure. Higher acetylene pressures are dangerous. If the cylinder is not fitted with a hand wheel valve control, any special wrench required must be placed on the cylinder while the cylinder is in service. On manifolds, one wrench for each manifold will suffice.
- Always leave the fuel gas cylinder valve wrench in place when the cylinder valve is open to be closed quickly in an emergency. Do not open acetylene valves more

than one-quarter turn.

- All cylinders, particularly acetylene, must be restrained securely in an upright position to prevent accidents. A non-vertical function for an acetylene cylinder allows the discharge of acetone through the regulator, potentially clogging passages and creating a fire hazard. It can also cause voids in the porous material inside the cylinder, leading to acetylene explosions.
- Never use copper tubing or other copper equipment with acetylene.
- Cylinders with arc or torch burns shall be removed from service immediately.

#### **F. Guidelines for Compressed Gas Cylinders – Storage**

1. Cylinders must be stored per local, state, and federal regulations and applicable fire codes and Compressed Gas Association (CGA) standards.
2. Names and hazard classes of the gases must be posted in the cylinder storage area.
3. Cylinders shall always be secured upright to protect against falling or rolling on a firm, level floor (ideally concrete), especially liquefied fuel cylinders, to keep the safety devices in the vapor phase.
4. Valves must be closed with valve protection caps secured when regulators are not on the cylinders. Caps should be hand tight and not forced or over tightened.
5. Cylinders (full and empty) must be anchored to a wall or bench clamp or secured within cylinder racks or stands. An appropriate restraint device (strap or chain) shall always be used.
6. Empty and full cylinders shall be stored separately with the storage layout designed so that cylinders made up of old stock can be removed first with minimum handling of other cylinders. Empty cylinders must be marked accordingly using the attached tear-off wire tag label or other suitable sign or tag or by writing "Empty" or "MT" in chalk on the cylinder. For laboratories, arrangements should be made for empty cylinders to be picked up by the supplier as soon as possible. Never try to refill a compressed gas cylinder.
7. Rotate stock of full cylinders, and use cylinders on a "first-in, first-out" basis.
8. Storage areas should be relaxed, dry, and well ventilated. Cylinders must be stored away from excessive heat sources, such as stoves, furnaces, radiators, electric welding tools, direct sunlight, and the presence of open flames. Cylinders should not be subjected to a temperature above 125 degrees Fahrenheit (52 degrees Celsius). Cylinders must be stored at least 20 feet from combustibles and incompatible materials, such as oil, gasoline, waste, and vegetation. They should not be exposed to excessive dampness, salt, corrosive chemicals, or fumes.
9. Cylinders must not be subjected to artificially created low temperatures without the approval of the supplier. Many sheets of steel undergo decreased flexibility at low temperatures.
10. Cylinders must be grouped, and the groups subsequently arranged by type of gas

contained. Incompatible gases, such as flammable and oxidizing, shall be separated by a minimum of 20 feet or by a noncombustible barrier of at least 5 feet high, having a fire-resistance rating of at least one-half hour—Post “No Smoking” signs.

11. Toxic gas monitors must be installed in toxic gas storage areas and set to alarm if a release is detected. The fire code may require exhausted enclosures.
12. Corrosive gases shall be managed with the same precautions as toxic gases. Gas distribution systems must be gas compatible.
13. Cylinders stored outside must be protected against severe weather, tampering, combustible waste, and the ground beneath to prevent rusting. Combustible material, including vegetation, shall be kept a minimum of 20 feet from cylinders. If snow or ice accumulates on a cylinder, thaw at room temperature or with water at a temperature not exceeding 125 degrees Fahrenheit (52 degrees Celsius).
14. Cylinders must be protected from objects that would cut, damage, or otherwise produce an abrasion on the surface of the metal. Cylinders should not be stored near elevators or gangways or in locations where heavy moving objects may strike or fall on them.
15. Store cylinders away from heavy traffic and emergency exits. Do not store cylinders in hallways.
16. Storage, use and handling areas must be secured against unauthorized entry or access to unauthorized personnel.
17. Gas cylinders should not be stored longer than one year without use.
18. Never store liquid or gas chlorine cylinders with ammonia cylinders.

#### **G. Guidelines for Compressed Gas Cylinders – Transport**

1. Connected equipment (e.g., regulators) must be removed before transport. Valves must be closed to prevent internal contamination, and removable valve protection caps shall be secured during handling and transport.
2. Wear suitable PPE when transporting cylinders. Leather gloves and safety footwear, for example, can provide some protection against falling/slipping cylinders crushing hands or feet during moving.
3. Use a suitable hand truck or cart in good condition designed for cylinder movement with the cylinder firmly secured. Avoid lifting/lowering cylinders on steps. Use ramps when available.
4. When moving gas cylinders short distances, rolling them on their bottom edges (edge-rolling) should be avoided unless the cylinder is on a smooth, level, firm surface. Sliding, dragging, or rolling cylinders on their sides is not permitted as it causes excessive wear and may weaken cylinder walls by metal erosion.
5. Cradles shall be used for hoisting. Lifting magnets shall not be used. Ropes, chains, or slings are not authorized when transporting cylinders unless provisions have been made on the cylinder for appropriate lifting attachments, such as lugs.

6. Avoid dropping and striking cylinders together. Do not drop cylinders as a method of transfer.
7. Do not lift cylinders by the cap, valves, or valve handwheels. Do not bear-hug cylinders to effect a lift.
8. Do not attempt to catch or restrain a falling cylinder.
9. Fuel gas and liquefied fuels must be stored and shipped.
10. Cylinders must be upright when they are transported in powered vehicles.
11. All cylinders with water weight of over 30 lbs. must have caps or other protection.
12. Valve protection caps must be on cylinders while transported, excluding welding gas moved about a localized work area on a specialized carrier/dolly.
13. Use a freight elevator when possible. If using a freight elevator is not possible, do not use an elevator with people on it or allow other people to ride on the elevator when transporting cylinders. When asphyxiant gases are transported in an elevator, send the cylinder up or down by itself if possible but only if the elevator can be made to not stop at other floors before it is removed.
14. Do not attempt to handle cylinders if you are tired, physically compromised, or under the adverse influence of medication.

#### **H. Gas Cylinder Distribution Systems**

1. Gas cylinder distribution systems, e.g., valves, regulators, tubing, must be compatible with the gas conveyed by the system. Do not use grease or oil on valves or other oxidizing gas connections.
2. Gas cylinder distribution systems supplying flammable, corrosive, or toxic gas must be inspected regularly for leaks. Leak tests may be performed using SNOOP or soapy water, using a gas detector, or by pressurizing the delivery system and evaluating pressure within the system over time (tightness testing). Leaks are most frequently detected at connections/fittings.
3. Flexible tubing is preferable for frequently detached and reconnected connections, e.g., between the cylinder and distribution system, regulator and distribution system, and equipment. Disconnecting and reconnecting rigid tubing can cause premature wear. Flexible stainless steel tubing options are available.
4. Gas distribution tubing passing through fire-rated walls or enclosures must be sealed to maintain the integrity of the fire rating, e.g., fire caulk.
5. Gas distribution tubing must be located sufficiently distant from electrical equipment such that arcing is not feasible.
6. Gas cylinder valves must be closed when gas is not used.

#### **I. Guidelines for Compressed Gas Cylinders – Emergencies**

1. **Minor Leak:** If a leak or a suspected leak occurs in a gas cylinder, attempt to stop the leak by tightening a valve or packing nut. If this does not work, attempt to situate the cylinder so that it is in a fume hood or under local exhaust ventilation such as a canopy hood or snorkel. If this cannot be done and if it is safe to do so, immediately transport

the cylinder outside the building away from possible fire or ignition sources to an accessible location from wind currents that might carry the gas to an ignition source. If the gas is flammable or toxic, place a warning against these hazards.

If it is not safe or physically possible to move the cylinder, notify those in the area and evacuate the site and building. Contact EH&S and inform the supplier for instructions on the return of the cylinder. If the minor leak involves corrosive or toxic gas, notify those in the area, secure the site, evacuate the building, and call 911.

2. Major Leak: If a major leak occurs, notify those in the area, and evacuate the building or area. Activate the fire alarm and call 911 when it is safe. Notify the supplier for instructions as to the return of the cylinder.
3. A safety data sheet (SDS) must be readily available for each gas type.
4. Emergency equipment, such as emergency eyewash, emergency shower, and fire extinguisher shall be available.
5. Emergency procedures must be developed and implemented for emergencies. Posting emergency procedures is recommended.

Note: Hydrogen gas' explosive limits range from 4% to 77% with ignition energy of just 0.02 millijoules; hydrogen fires may be invisible.