



## **STANDARD OPERATING PROCEDURE Compressed Gas Cylinders, Pressurized Equipment and Pressure Vessels**

### **Definition**

A compressed gas is defined as any single gas or mixture of gases in a container with a pressure exceeding 40 psi at 70°F/21°C, 104 psi at 130°F/55°C, or any flammable liquid with an absolute vapor pressure exceeding 40 psi at 100°F/38°C.

### **Hazards**

Cylinders of compressed gases can pose a chemical hazard as well as a physical hazard. If the valve were to break off a cylinder, the amount of force present could propel the cylinder through a brick wall. For example, a cylinder of compressed breathing air used by SCUBA divers has the explosive force of 1 ½ pounds of TNT.

### **Container Requirements for Compressed Gases**

1. All compressed gas cylinders or containers delivered to or shipped from the University must be marked, labeled, stored, and handled in accordance with all applicable rules and regulations, including DOT, OSHA, and NFPA standards.
2. The contents of each cylinder and container must be clearly identified by tag or stamp on the cylinder.
3. University faculty, staff, and students must not remove or alter any identification on a compressed gas cylinder.
4. Do not purchase a larger cylinder size than necessary. Only gases in returnable containers should be selected for purchase—lecture bottles are an exception.

### **Storage of Compressed Gas Cylinders**

1. Storage areas for compressed gas cylinders must be designed to accommodate the gases used and provide adequate spacing and/or segregation in accordance with applicable building codes and regulations. Compressed gas cylinder storage areas must be segregated from exit corridors and egress paths.
2. Storage areas should be designated by hazard class and marked clearly with appropriate warning signs that restrict access.
3. Consideration must be given to separate storage of full and empty containers. Incompatible gases must be separated by at least 20 feet or separated by using appropriate fire rated barriers.
4. The cylinder storage area should be dry, free of combustible materials and debris (e.g. timber, card board, packaging materials) to prevent flame impingement on gas cylinders in a fire, well-ventilated, and be of fire-resistant construction when necessitated by the gas in storage.
5. Compressed gas cylinders must not be stored near sources of heat and ignition or near corrosive chemicals or fumes.
6. Compressed gas cylinders must not be stored near unprotected platform edges or in any location where heavy moving objects may strike or fall on them.



7. All compressed gas cylinders (whether empty or full) **must** be secured in an upright position using an approved chain, strap, or floor device to prevent falling. There should be no more than five cylinders per securing device. When small-size cylinders are in use, they shall be attached to a cylinder stand or an apparatus of sufficient size to render the entire assembly stable.
8. Approved chains or straps should be secured around the top 1/3 of the cylinder. Securing devices should never be around the neck, regulator, or bottom 1/3 of the cylinder.
9. All compressed gas cylinders must be fitted with a protective valve cap or guard while in storage.
10. If the use of small non-refillable cylinders (lecture bottles) is unavoidable, they should be secured in a device, cage, or box designed for cylinders 18 inches or smaller.
11. Toxic gases (such as F<sub>2</sub>, CO, and H<sub>2</sub>S) should be stored and used in a chemical fume hood. If this is not feasible, the area of use **must** be equipped with a detection system specific to the toxic gas or inhalation hazard. Refer to the [UTA Standard Operating Procedure for Toxic Gas Use](#).
12. Oxygen should be stored in an area that is at least 20 feet away from any flammable or combustible materials, or separated from them by a noncombustible barrier at least 5 feet high and having a fire-resistance rating of at least 1/2 hour.
13. Position all cylinders so that the main valve is always accessible.

### **Safe Handling of Compressed Gas Cylinders**

1. Persons handling compressed gas cylinders must:
  - Be familiar with the hazards of the compressed gas.
  - Always use a cylinder cart or other transport device to move cylinders in a secured fashion. **Never** drag a cylinder by valves or caps or roll a cylinder in a horizontal position. Compressed gas cylinders should be transported with the cylinder cap securely fastened.
  - Never use a compressed gas cylinder as a support or door stop.
  - Keep caps on cylinders unless connected to dispensing equipment systems.
  - Never expose cylinders to temperature extremes, direct flame, or heat.
2. Never use a gas cylinder that cannot be positively identified. Color-coding is not a reliable way of identifying a gas cylinder because the colors can vary from supplier to supplier.
3. Empty compressed gas cylinders must be:
  - Closed.
  - Secured at all times.
  - Labeled to indicate “empty.”
4. Regulators control the rate at which gas is delivered from the cylinder so the gas may be used safely. Never discharge a gas without the use of a regulator. Compressed gas piping, regulators, and flow control equipment must be:
  - Compatible with the chemical and physical properties of gas.
  - Capable of withstanding gas supply pressures.
  - Installed and operated by trained and qualified persons familiar with the specific hazards of the gases in use.



- Grounded to minimize sparks due to static discharge when using flammable gas.
  - Provided with a means for safely purging the system and devices to prevent backflow of gases or liquids into the gas storage cylinders when using hygroscopic corrosive gases, such as anhydrous HCl.
5. Always use the appropriate regulator on a cylinder.
    - If a regulator will not fit a cylinder's valve, replace the cylinder, not the regulator.
    - Do **not** ever attempt to adapt or modify a regulator to fit a cylinder for which it was not designed. Regulators are designed to fit only specific cylinder valves to avoid improper use.
  6. Inspect regulators, pressure relief devices, valves, cylinder connections, and hose lines frequently for damage.
  7. Do not use oil or grease on any cylinder component of an oxidizing gas because a fire or explosion can result.
  8. Never transfer gases from one cylinder to another.
    - The gas may be incompatible with the residual gas remaining in the other cylinder.
    - The gas may be incompatible with the material of which the cylinder is made.
  9. Never completely empty cylinders.
    - Leave approximately 25 psi of pressure.
    - This will prevent any residual gas in the cylinder from becoming contaminated.

### **Emergency Procedures for Compressed Gas Cylinders**

1. Personnel should be aware of common emergency situations involving compressed gases and their associated hazards, such as:
  - An unsecured cylinder may tip and become damaged in a manner that the release of internal pressure can cause the cylinder to become a dangerous high-speed projectile.
  - A fire threatening the cylinder can cause a rupture or explosion.
  - A flammable gas leak can cause a buildup of explosive gases.
  - A leak can cause high concentrations of gas that exceed safe breathing levels or an inert gas leak can cause an oxygen-deficient atmosphere that is a threat to life safety.
  - An unplanned chemical reaction may cause a cylinder rupture or explosion of apparatus.
2. Fires involving compressed gas cylinders should be handled with extreme caution.
  - Do not take unnecessary risks to save equipment—evacuate the area.
  - Only when safe to do so, release pressure in affected pipelines and shut off equipment prior to evacuation.
  - If safe to do so, shut off gas supply to ignited flammable gas leaks or allow fire to burn out while controlling the ignition of surrounding materials.
  - Never attempt to extinguish a flammable gas leak without stopping the flow of gas.
  - Any compressed gas cylinder involved in a fire must be taken out of service and returned to the supplier.



3. Some common leak points and their potential repairs:
  - Valve outlet /regulator connection: dirt in connection, damaged connector or washer.
  - Valve stem spindle: tighten adjustable gland nut  $\frac{1}{4}$  turn with valve stem loosened or tighten lock nut if present on gland fitting.
  - Cylinder valve to cylinder joint: cannot be repaired in the field, remove from service. Label and return to supplier.
  - Valve closure: tighten valve or if defective, set aside, label and return to supplier.
  - Leaking gas control equipment/pipelines: isolate gas supply, release pressure, and purge equipment of hazardous gas before attempting repair.
  - Use only wrenches or other tools supplied by the cylinder manufacturer to open a valve.
  - Open cylinder valves slowly.

### **Disposal of Compressed Gas Cylinders**

1. Contact your cylinder vendor to return damaged, excess, or unknown cylinders. All users will be responsible for returning all cylinders to the manufacturer/distributor.
2. Cylinders of gases classified as corrosive or highly reactive shall be returned to the manufacturer/distributor within one year of the purchase date and all other gases within three years.

### **Pressurized Equipment and Pressure Vessels**

Common examples of pressure vessels or pressurized equipment are steam boilers, autoclaves, compressor tanks, pressurized research equipment, reactors, and calorimeters. University employees should follow these basic safety guidelines when working with pressure vessels or pressurized equipment:

1. Pressurized equipment used at pressures at or above 103 kPa gauge (15 psig) must be designed and constructed by qualified individuals for use at the expected temperature, pressure, and other operating conditions.
2. Pressure equipment must be fitted with a pressure relief device, such as a rupture disc, relief valve, or blow down valve. This pressure relief device must be vented to a safe location.
3. Laboratory pressure vessels or equipment operated at pressures above 103 kPa gauge (15 psig) must be operated and maintained according to manufacturer's instructions, the design limitations of the equipment, and applicable codes and regulations.
4. This equipment must be inspected at least annually.
5. Any significant change in the condition of the equipment, such as corrosion, cracks, distortion, scale formation, chemical attack, weakening of the closure, or the inability of the equipment to maintain pressure, should be documented.
6. Equipment exhibiting any of the above changes must be removed from service immediately and shall not be returned to service until repaired and approved by a qualified person.

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