

# Compressed Gases and Cryogenics

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## University of Tennessee Safety Guide HM-011

**Document Contact:** EHS

**Date effective:** January 1, 2009

**Revision Date:** April 19, 2018

### Purpose

This guideline adheres to the Occupational Safety and Health Administrations (OSHA) compressed gas standards as found in 29 CFR 1910.101.

### Scope and Applicability

This document serves all University department members working within University owned, leased or subsidiary facilities. This guideline is applicable to daily users and those who only occasionally have cause to use the equipment.

### Abbreviations and Definitions

#### Definitions

According to OSHA Hazard Communication Standard a compressed gas is defined as the following:

- A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 pounds per square inch (psi) at 70°F (21.1°C); or
- A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C); or
- A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by the American Society for Testing and Materials (ASTM) 323-72.

Compressed gases can be toxic, flammable, oxidizing, corrosive or inert. In the event of a leak, inert gases can quickly displace air in a large area creating an oxygen-deficient atmosphere, toxic gases can create poisonous atmospheres and flammable or reactive gases can result in fire and exploding cylinders.

### Roles and Responsibilities

#### Managers and Supervisors shall:

- Ensure that equipment associated with the movement, storage and use of compressed gas cylinders is available and properly inspected before being used.
- Ensure department members conducting work associated with compressed gas and/or compressed air equipment have the appropriate training and understand all aspects of safety associated with this equipment.

#### Employees and Students shall:

- Complete the University's compressed gas training prior to working with compressed gases in their respective departments.
- Wear the appropriate personal protective equipment for the task being performed.
- Inspect hazard control measures and personal protective equipment prior to each use.



- Maintain awareness of hazards associated with the handling and use of compressed gas.

### **EHS Shall:**

- Perform annual safety inspections in areas where compressed gas cylinders are used on campus.
- Review and revise the Compressed Gas Guideline on a routine basis.
- Provide training for people who will use compressed gas cylinders in their jobs.

## **Procedures**

### Recommended Safe Practices for Handling/Storage

#### **General Safety Requirements**

1. All containers shall have their contents identified on the label. Color shall not be used to identify container content. Containers not bearing a legibly written, stamped, or stenciled identification shall not be used and shall be returned to the supplier.
2. The fittings on vessels should not be modified under any circumstances.
3. All compressed gas cylinders, either in use or in storage (empty or full), shall be secured in an upright position by means of a strap, chain or rack. NOTE: Chains and straps secured to the wall should be attached to studs rather than sheet rock to ensure secure points of attachment and shall be around the upper third of the cylinder.
4. Suitable hand trucks, equipped with safety chains, shall be utilized when transporting gas cylinders. Cylinders shall not be rolled in the horizontal position or dragged. Never use the cylinder valve as a handle to move a cylinder.
5. Ropes, chains or slings shall not be used to suspend containers unless equipped with appropriate lifting attachments such as lugs. Where attachments have not been provided, suitable cradles or platforms to hold the containers shall be used for lifting.
6. Protective valve caps must be in place when cylinders are not in use. Do not switch caps, since not all suppliers use the same cap threads.
7. Container valves shall be closed at all times (full or empty) except when the container is in use. Valve outlets shall be pointed away from all personnel when the valve is being opened.
8. All cylinders, lines, and equipment used with flammable compressed gases shall be grounded. Cylinders used in conjunction with electric welding shall not be grounded or used for grounding.
9. When in use, all cylinders must be equipped with an appropriate regulating device. All regulators must be marked to identify the gas (or group of compatible gases) with which the regulator is to be used. Regulator threads must match cylinder valve outlet threads. Adapters shall never be used to attach a regulator to a cylinder for which it is not designed.
10. When a cylinder is in use, a hand wheel, valve handle, spindle key or special tool to open the cylinder valve shall be attached to the cylinder so that it will be available immediately in the event of an emergency.
11. Cylinders containing compressed gases shall be used only in well-ventilated areas.
12. Cylinders containing toxic or flammable gases must be stored in an approved storage area. Storage areas shall be prominently posted with the hazard class or the name of the gases stored.
13. Containers shall not be stored near elevators, walkways, unprotected platform edges, or in locations where heavy moving objects may strike or fall on them. Stored containers (inside or outside) shall not obstruct exit routes or other areas normally used or intended for the safe exit of personnel.
14. Cylinders containing oxidizing gases, such as oxygen and nitrous oxide, shall be stored separately from flammable gases or liquids. Separation will be 25 feet or by a fire-rated wall.

15. Flammable gases shall be stored in well-ventilated areas away from oxidizers, open flames, sparks, and other sources of heat or ignition.
16. Empty cylinders shall be so identified and stored separately from full or partially full cylinders.
17. Compressed gas cylinders shall be used only for their intended purposes.
18. Compressed gases should be handled only by experienced and properly instructed personnel.

### **Cryogenic Liquids**

Cryogenic liquids are gases handled in liquid form at relatively low pressures and extremely low temperatures (usually below -130 °F (-90 °C)). Because of their low temperatures, cryogenic liquids are handled in double-wall, vacuum-insulated containers to lessen evaporation and venting of gas. Some cryogenic liquids in small quantities are also handled in open, low pressure, thermos-type containers (dewars) in laboratory work.

1. When handling cryogenic liquids, wear suitable eye protection, such as a face shield and safety glasses or safety goggles.
2. Wear hand protection, such as insulated gloves, to prevent contact with cold liquid, cold gas, and cold equipment or piping. Gloves should be loose fitting so that they can be readily removed in the event liquid is splashed into them.
3. Wear cuff-less trousers over (outside) high-topped shoes to prevent spills from being trapped in shoes or allowed to contact the feet.
4. Handle and store containers in an upright position.
5. The containers shall not be dropped, tipped over, or rolled on their sides. Use a four-wheel hand truck designed to move such containers to move cryogenic liquefied gas containers with a capacity greater than 20 gal (76 L).
6. Store and handle cryogenic liquefied gas containers in well-ventilated areas to prevent hazardous concentration of the gas.
7. Containers and equipment assigned for a specific cryogenic liquefied gas service shall not be used for the storage or use of another cryogenic liquefied gas.
8. Provide gas containers with pressure relief devices adequate to relieve excessive pressures within the containers.
9. Where cryogenic liquefied gas or cold gas may be trapped in piping between valves, equip the piping with a pressure relief device. Only transfer lines designed for cryogenic liquefied gases shall be used. It is recommended that all vents be piped to the exterior of the building.
10. Store and transfer cryogenic liquids under positive pressure to prevent the infiltration and solidification of moisture, air, or other gases.

### **Personal Protective Equipment**

General requirements for the use of personal protective equipment include wearing protective gloves when using gases that are harmful to the skin. Aprons or other protective clothing may be needed depending on the risk of skin contact. University department members are instructed to consult the safety data sheet before handling a compressed gas for appropriate manufacturer personal protective equipment recommendations.

Eye protection must always be worn when handling and working with compressed gases. In some cases additional protection may be needed in the form of a face shield when working with compressed gases.

### **Inspection**

Environmental Health and Safety (EHS) shall conduct hazard surveillance of all laboratories, and other areas on campus that use compressed gas cylinders (i.e. shop areas) annually. During the annual site visit the

storage and use of compressed gas cylinders shall be evaluated. Deficiencies shall be noted on the standard inspection form and communicated to the responsible individual. The person responsible for the area that contains cylinder deficiencies shall make corrections and respond to the EHS.

### **Chemical Inventory**

Compressed gas cylinders shall be included on the chemical inventory for each department that contains these vessels. For additional information consult EHS or safety guideline number EC 4 regarding compressed gas cylinders and chemical inventory.

### **Training and Information**

All personnel working with compressed gas cylinders shall be trained in safety and proper procedures. Training should include the following as a minimum, as applicable:

- General safety procedures for use with compressed gas cylinders or medical gases including:
  - safety hazards associated with the gases
  - hazards associated with high-pressure cylinders
  - hazards associated with the specific equipment
  - hazards associated with contaminated tools, parts, etc.
- Procedures to prevent cross connections of medical gas pipelines. NOTE: Many older outlets are not inherently safe from cross connection due to common threads or fittings used for different gases.
- Mechanical skills required for work on equipment.
- Procedures to follow prior to any shutdown of a service or during an emergency.
- Location, operation, and areas controlled for all valves.

Training should be conducted and documented annually. Training records shall be kept for at least three years.

### **References**

Compressed Gas Association (CGA) Pamphlet, CGA P-1, "Safe Handling of Compressed Gases in Containers"

NFPA Codes 43-A, 43-C, 45, 50-A, 51, 58, 70, and 77

OSHA 29 CFR 1910, Subpart H

### **Appendices**

Appendix A: Compressed Gas Guidelines

### **Disclaimer**

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