

Material Handling and Storage of compressed gases and Air equipment

Compressed gases can be toxic, flammable, oxidizing, corrosive, inert, or some combination of these hazards. Compressed gas cylinders are used in many workplaces to store gases that vary from extremely flammable (acetylene) to extremely inert (helium). Many compressed gas cylinders are stored at extremely high pressures (up to 2,500 pounds per square inch gauge or PSIG). A sudden release of these gases can cause a cylinder to become a missile-like projectile. Cylinders have been known to penetrate concrete-block walls. If handled properly compressed gas cylinders are safe. If handled improperly, the same cylinders can present a severe hazard to you and the surrounding area.

Appropriate care in the handling and storage of compressed gas cylinders is essential. The following are six general recommendations.

1. **Know and Understand Gas Properties:** Know and understand the properties, uses, and safety precautions before using any gas or gas mixture. Consult Material Safety Data Sheets (MSDSs) for safety information on the gases that you will be using.
2. **Check Equipment:** Leak test lines and equipment before they are used. Lines and equipment should be designed and maintained to handle full cylinder pressure. Materials of construction should be compatible with the gases being used.
3. **Develop Emergency Plans:** Be aware of potential hazards and develop plans to cover all possible emergencies. Include information about the types of gases used on your laboratory's Emergency Information Poster.
4. **Provide Personal Protection:** Wear suitable protective clothing, including gloves and face protection. Safety equipment, such as self-contained breathing apparatus and fire extinguishers, should be located near hazardous areas. Stay well informed of the potential hazards of the gases with which you are working.
5. **Follow Regulations:** Follow all federal, state, and local regulations pertaining to the storage and use of compressed gas cylinders. Compressed Gas Association (CGA) Pamphlet P-1 provides excellent guidance. Follow the National Fire Protection Association (NFPA) codes, especially for flammable products.
6. **When in Doubt, Contact Environmental Health & Safety:** If you are unfamiliar with the hazards associated with a particular gas or unsure of the correct handling and storage procedures, call Environmental Health & Safety at 8-5294.

TYPES OF HAZARDS:

Primary Hazards

The following is an overview of the primary hazards to be avoided when handling and storing compressed gases.

- **Asphyxiation:** Simple asphyxiation is the primary hazard associated with inert gases. Because inert gases are colorless and odorless, they can escape into the atmosphere undetected and quickly reduce the concentration of oxygen below the level necessary to support life. The use of oxygen monitoring equipment is strongly recommended for enclosed areas where inert gases are being used.

- 🔊 **Fire and Explosion:** Fire and explosion are the primary hazards associated with flammable gases, oxygen, and other oxidizing gases. Flammable gases can be ignited by static electricity or by a heat source, such as a flame or a hot object. Oxygen and other oxidizing gases do not burn, but will support combustion of flammable materials. Increasing the concentration of an oxidizer accelerates the rate of combustion. Materials that are nonflammable under normal conditions may burn in an oxygen-enriched atmosphere.
- 🔊 **Chemical Burns:** Corrosive gases can chemically attack various materials, including fire-resistant clothing. Some gases are not corrosive in their pure form, but can become extremely destructive if a small amount of moisture is added. Corrosive gases can cause rapid destruction of skin tissue.
- 🔊 **Chemical Poisoning:** Chemical poisoning is the primary hazard of toxic gases. Even in very small concentrations, brief exposure to these gases can result in serious poisoning injuries. Symptoms of exposure may be delayed.
- 🔊 **High Pressure:** All compressed gases are potentially hazardous because of the high pressure stored inside the cylinder. A sudden release of pressure can cause injuries by propelling a cylinder or whipping a line.
- 🔊 **Improper Handling of Cylinders:** Compressed gas cylinders are heavy and awkward to handle. Improper handling of cylinders could result in sprains, strains, falls, bruises, and 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.

Regulatory requirements

Responsibilities

Users of Compressed Gas Cylinders must read, understand, and follow the markings on the cylinder, the label(s) on the cylinder, and the material safety data sheets (MSDS). Appropriate personal protective equipment should be worn.

Environmental Health and Safety is responsible for providing guidance and information on compressed gas cylinder use, transportation and storage.

Vendors must deliver properly labeled compressed gas cylinders with safety caps in place.

Procedures

Labeling: Compressed gas cylinders shall be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable. Whenever practical, the marking shall be located on the shoulder of the cylinder (OSHA Standard 29 CFR 1910.253 (b) (1) (ii)).

1. A durable label should be provided that cannot be removed from the compressed gas cylinder.
2. Compressed gas cylinders that do not clearly identify its contents by name should not be accepted for use.
3. Color-coding is not a reliable means of identification; cylinder colors vary from supplier to supplier, and labels on caps have no value because many caps are interchangeable.

4. Tags should be attached to the gas cylinders on which the names of the users and dates of use can be entered.
5. If the labeling on the gas cylinder becomes unclear or defaced so that the contents cannot be identified, the cylinder should be marked "contents unknown" and the manufacturer must be contacted regarding appropriate procedures for removal.

Handling Cylinders: Serious accidents may result from the misuse, abuse, or mishandling of compressed gas cylinders. Workers assigned to the handling of cylinders under pressure should be properly trained. Handle cylinders of compressed gases as high-energy sources and therefore as potential explosives. Observance of the following rules will help control hazards in the handling of compressed gas cylinders:

1. Accept only cylinders approved for use in interstate commerce for transportation of compressed gases
2. Always wear proper Personal Protective Equipment (PPE).
3. Cylinders must always be transported on wheeled cylinder carts with retaining straps or chains.
4. Cylinders should be secured in a boot or by a chain to a fixed support to prevent them from being dropped or from falling over.
5. Do not remove or change numbers or marks stamped on cylinders.
6. Cylinders should not be banged, dropped or permitted to strike each other or against other hard surfaces.
7. 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 by an ignition source such as a spark or cigarette.
8. Do not use the valve cover to lift cylinders; they could be damaged and become unattached causing the cylinder to drop on a hard surface possibly resulting in an explosion.

Storage: The rules listed below will minimize hazards when storing compressed gas cylinders. Please see figures 1.1 – 1.4 for examples of proper compressed gas cylinder storage.

1. Store cylinders upright and secure them with a chain, strap, or cable to a stationary building support (i.e. Structural Beam) or to a cylinder cart to prevent cylinders from tipping or falling.
2. Liquefied flammable gas cylinders should be stored in an upright position, or such that the pressure relief valve is allowed to remain in the gas phase. Cylinders loaded with liquefied gas are not completely filled; a small vapor space is left to allow for expansion if the cylinder is heated.
3. Use only approved containers to store and transport liquid nitrogen. Containers should have vented-lids to prevent spillage when carried.
4. Oxygen cylinders should be kept at a minimum of 25 feet away from fuel-gas cylinders, such as acetylene and combustible materials, or separated by a non-combustible barrier (such as a wall) at least 5 feet high with a fire-resistance rating of at least one-half hour.
5. Flammable gas cylinders should not be stored with oxygen, or nitrous oxide cylinders, or adjacent to oxygen charging facilities.
6. Store cylinders in a dry, well-ventilated area away from flames, sparks, or any source of heat or ignition.

7. Mark the cylinder storage areas with proper precautionary signs, such as "Storage of flammable, oxidizer, or toxic materials."
8. Place cylinders in a location where they will not be subject to mechanical or physical damage, heat, or electrical circuits to prevent possible explosion or fire.
9. Segregate empty cylinders from full cylinders.
10. Caps used for valve protection should be kept on the cylinders at all times, except when the cylinder is actually being used or charged. Cylinder valves should remain closed.
11. Never plug, remove, or tamper with any pressure relief device. Under normal conditions, these containers will periodically vent the product.
12. Cylinders should not be exposed to an open flame or to any temperature above 125 degrees Fahrenheit.
13. Cylinders should not be exposed to continuous dampness, stored near salt or other corrosive chemicals or fumes. Corrosion may damage cylinders and cause their valve protection caps to stick.
14. When empty cylinders are to be returned to the vendor, mark them "Empty" or "MT."

Transporting:

1. Cylinders transported by wheeled truck must be fastened securely in an upright position so that they will not fall or strike each other (see figure 2.1 for an example).
2. Cylinders should not be transported without safety caps. A cylinder's cap should be screwed all the way down on the cylinder's neck ring and should fit securely. Do not lift cylinders by the cap. The cap is for valve protection only.
3. Cylinders should not be transported with the regulator attached to the cylinder.
4. Always use a cylinder cart to move compressed gas cylinders. Refrain from sliding, dragging, or rolling cylinders on their edge
5. Only one cylinder should be handled (moved) at a time
6. If the cylinder is to be shipped by an interstate carrier, it must have a D.O.T. label

Returning Cylinders

When returning an empty cylinder, close the valve before shipment, leaving 25 psig of residual pressure in the cylinder. Replace the valve cap and any valve outlet caps or plugs originally shipped with the cylinder. If repair is needed on a cylinder or its valve, be sure to mark it and return it to the supplier.

Personal Protective Equipment (PPE): Avoid Skin Contact. When handling gases that are harmful to the skin, protective gloves and/or aprons must be worn to prevent skin absorption. Choose clothing made of materials that resist penetration or damage by the compressed gas. Refer the compressed gas cylinder's MSDS for recommendations pertaining to PPE. If the information is not provided on the MSDS, contact the supplier for specific information. **Protect Your Eyes and Face.** Workers should wear safety goggles/glasses when handling and using compressed gases. In some cases, a face shield should be worn.

Review Questions

1. **List** the primary hazards to avoid when handling hazardous gases
2. **List** two means by which labels may be marked.
3. What is the minimum distance that oxygen cylinders should be kept from fuel-gas cylinders, such as acetylene and combustible materials?
4. If there is not enough room to keep oxygen cylinders separated by the minimum distance then a non combustible barrier wall may be used.
 - a. How high must this wall be?
 - b. What fire resistance rating must this wall have (ie length of time before it succumbs to fire)?
5. Give two examples of appropriate precautionary signs that cylinder storage areas should have.
6. Outline five (5) precautions that may be taken when handling cylinders.

References:

www.med.cornell.edu/ehs/updates/compressed_gases.html and

http://web.princeton.edu/sites/ehs/hazardous_guide/6.html