Carolinas HealthCare System

# Compressed Medical and Industrial Gases

## Plant Operations and Maintenance

This self-directed learning module contains information you are expected to know to protect yourself, our patients, and our guests.

**Target Audience:** **Healthcare workers who are responsible for working with compressed medical and industrial gases.**

Contents



# Compressed Medical and Industrial Gases

## Instructions:

The material in this module is an introduction to important general information and procedures for handling, storing, and transporting compressed gas. After completing this module, contact your supervisor to obtain additional information specific to your department.

- Read this module.
- If you have any questions about the material, ask your supervisor.
- Complete the online posttest for this module. Once you pass the posttest, print it or a copy of your transcript and give it to your manager.
- The Job Aid on page 10 should be customized to fit your department's policies and procedures and then used as a quick reference guide.
- Record the date you completed the module on your **Employee Annual Continuing Education Record.**

## Learning Objectives:

**When you finish this module, you will be able to:**

- Explain the difference between compressed medical and industrial gases.
- Describe hazards associated with the use of a compressed gas cylinder.
- Describe how to properly use and handle compressed gases.
- Describe how to properly store compressed gases.
- Describe how to safely transport compressed gases.

# Compressed Medical and Industrial Gases

## Definitions

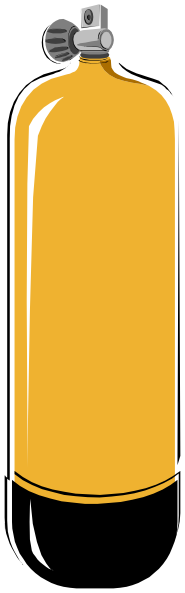
Gases stored under pressure in cylinders are called **compressed gases**. These include oxygen, nitrous oxide, and other gases. The gas comes out of the tank through a regulator to reduce and control the pressure of the discharged gas.

1. **Cryogenic gas** - A gas with a boiling point below minus 150 degrees F is usually considered a cryogen.

2. **Industrial gas** - Industrial gases are produced to varying degrees of purity. Industrial gases include oxygen, nitrogen, argon, carbon dioxide, helium, hydrogen, and numerous others.

3. **Medical gas** - Medical gases are produced to strict levels of purity. A medical gas is manufactured in accordance with the FDA's current Good Manufacturing Practice (GMP), and is listed in the US Pharmacopoeia (USP) or the National Formulary (NF).

**Note**: Carbon dioxide, which has a boiling point of minus 109º F, is not considered a cryogen; however, its low temperature hazards are similar to a true cryogen.



## Key Points

Cylinders must be constructed, tested, and maintained in accordance with the US Department of Transportation and FDA specifications and regulations.

1. Manufacturers/suppliers must identify contents by attached labels or stencils naming the components and stating the proportions.
2. Users must identify contents by reading the labels before use. Labels must not be defaced, altered, or removed. Labels must be legible.
3. Users must make sure the threads or pins on the regulator-to-cylinder valve connections are properly mated.
4. Connections are designed with one of **two different types of safety systems:**
    5. **Pin Index Safety Systems,** or
    6. **Diameter Index Safety Systems**.
7. **Never** force connections that do not fit, and **never** change adapters to force them to fit.

## Hazards

If a cylinder without a valve protection cap falls, the cylinder valve could break off. Depending on cylinder size, quantity of gas within the cylinder, and the size of the break, the cylinder could be propelled rapidly and/or violently after landing on the floor. This may cause the damaged cylinder to act as a missile or projectile. It may be so forceful that it may actually go through a concrete wall causing injuries and/or property damage.

Carefully review the following safe practices presented in this module for:

- Handling Cylinders
- Moving Cylinders
- Storing Cylinders
- Using Gases
- Transporting Gases
- Non-Interchangeable Connectors

## Safe Practices for Handling

1. Cylinder contents are under high pressure (typically over 2000 psi), so always use the appropriate pressure regulating device for product withdrawal.
2. Never permit oil, grease, or other readily combustible substances to come in contact with cylinders, valves, regulators, gauges, hoses, and fittings. Oil combined with oxidizing gases (oxygen, nitrous oxide) may create a greater risk for fire or explosion.
    a. Do not handle cylinders or apparatus with oily hands or oily gloves.
    b. Do not lubricate any part of a compressed gas cylinder with oil or any other combustible.
3. Keep connections to piping, regulators, and other appliances tight to prevent leakage. Keep apparatus connections in good condition.
4. Identify the contents of a compressed gas cylinder or cryogenic liquid before handling the cylinder or connecting it to a system. Discharging a gas or cryogenic liquid into a system not intended for the material could cause a fire, explosion, equipment failure, gas leak or other hazard resulting in serious or fatal injury.
5. Sparks and flames shall be kept away from cylinders.
6. Do not subject any part of any compressed gas cylinder to a temperature above **125 degrees Fahrenheit** or to artificially low temperatures.

    > Do not place cylinders where they might become part of an electric circuit.

    > The cylinder valve shall be opened slowly, with the face of the indicator on the regulator pointed away from all persons.

    > The cylinder valve must be fully **open** while the cylinder is in use. Valves are to be closed at all times, except when gas is actually being used.
7. Inspect cylinders for missing caps, medical lot numbers, labels, and dust caps. If not identified, return to the supplier without using.
8. Before placing cylinders into service, remove any paper wrapping so the label is visible.
9. Do not tamper with, deface, or alter cylinder markings or labels used for identification.
10. A cylinder shall never be draped with any materials such as hospital gowns, masks, or caps.
11. When replacing or returning an empty cylinder, **close** the valve, and before shipping replace **valve protective caps or plugs,** if used.
12. Never **bleed** a cylinder completely **empty**; leave some residual pressure.
13. Do not use cylinders with evidence of physical damage, leaks, surface contamination, or tampering. Do not attempt any cylinder repairs; report the condition to your gas supplier with details and serial number of cylinder.
14. Only persons trained in compressed gas safety may handle cylinders.

## Safe Practices for Moving Cylinders

1. Use only approved carts, handtrucks, and appropriate holders when moving cylinders.
2. When moving cylinders keep caps on cylinders where caps are provided for valve protection.
3. Never **drop** cylinders or permit them to **strike** each other.
4. Never use cylinders as rollers or supports.
5. Avoid dragging or sliding cylinders. It is safer to move large cylinders with a suitable approved handtruck, ensuring the cylinder is restrained with a chain, strap, or hook.
6. Never lift a cylinder by its cap or valve.

## Safe Practices for Storing and Labeling Cylinders

The following are important general recommendations for storage and labeling:

1. Read the product MSDS, caution labels, and equipment guides before use.
2. Keep cylinders upright and secure them against being knocked over.
3. Keep cylinder valves closed and caps or protection devices in place while cylinders are not in use or are empty.
4. Practice first-in, first out to avoid aging the inventory. Store compressed gas cylinders in an approved cool, dry well-ventilated area that is secure and accessible only to authorized personnel. .
5. Store empty cylinders in a separate area from full cylinders, and label areas appropriately.
6. Partially used cylinders shall be stored with Empty cylinders.
7. Protect cylinders from excessive increases in temperature. Do not store cylinders near radiators or other sources of heat.
8. Do not store oxidizing gases near oil, grease, or combustible materials. Keep sparks and flame away.
9. All compressed gas cylinders shall be secured when in storage or use. Store all cylinders in an upright position and secure them from being knocked over and damaged.
10. NEVER use cylinders as a support, doorstop, or a coat rack.

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## Safe Practices for Connecting Cylinders

Before attempting to connect a cylinder to a system, be certain of the following:

1. Personnel using the cylinder are trained and knowledgeable regarding the product, cylinder, fittings, equipment, and proper connection procedures.
2. The cylinder is clearly and properly labeled with the identification of the contents, and there are no conflicting markings, labels, or coloring. ***Do not rely solely on the color of the cylinder to identify the contents*.** If there is any conflict or doubt about the contents, do not use the cylinder.
3. Make sure the contents are the correct product for use in the system.
4. The connection(s) on the cylinder and the system must fit together properly, without being too loose or too tight. A proper connection will go together smoothly. Do not use adapters or excessive force.

## Safe Practices for Using Gases

The release of high-pressure gas may be hazardous unless adequate means are provided for reducing the gas pressure to usable levels and for controlling the gas flow. **Pressure-reducing regulators** must always be used when withdrawing contents from cylinders. Such devices deliver a constant safe working pressure.

**Needle valves** without regulating mechanisms must not be used in place of pressure reducing regulators because excessive pressures may develop downstream of such devices and result in damage to equipment or injury to personnel.

When using gases,

1. Do not remove valve protection cap until ready to withdraw contents or to connect to a manifold.
2. On all cylinders, with the exception of those containing flammable gas (i.e., acetylene), after removing the valve protection cap and prior to putting on the regulator, slightly open the valve for an instant to clear the opening of possible dust and dirt.
3. When opening the valve, point the outlet away from yourself and others.
4. Never use wrenches or tools to open valves, except those provided or approved by the gas supplier. Never hammer the valve wheel to open or to close the valve.

5. Make sure the threads or pins on the regulator-to-cylinder valve connections are properly mated.
6. Connections are designed with one **of two different types of safety systems:**
    a. **Pin Index Safety Systems, and**
    b. **Diameter Index Safety Systems**.
7. **Never** force connections that do not fit, and **never** change adapters to force them to fit.
8. Never permit gas to enter the regulating device suddenly. Always **open** the cylinder valve **slowly**.
9. Before disconnecting the regulating device, close the cylinder valve.
10. Valves must be closed at all times except when the gas is actually being used.


## Signs

A precautionary sign, readable from a distance of five feet will be displayed on each door or gate of the storage room or enclosure. For locations storing cylinders containing only oxygen or medical gas, the sign wording must include the following:

**CAUTION:**
**Medical Gases**
**No Smoking or Open Flame**

Locations containing positive pressure gases other than oxygen and medical air shall have their door(s) labeled substantially as follows:

# Compressed Medical and Industrial Gases

**CAUTION**
**Positive Pressure Gases**
**No Smoking or Open Flame**
**Room May Have Insufficient Oxygen**
**Open Door and Allow Room to Ventilate**
**Before Entering**

## Safe Practices for Transporting

When using and transporting compressed gases, follow these guidelines:

1. Make sure the cylinder is secure in an approved holder or transported with an approved handtruck, and secured with a chain, strap, or other approved device.
2. When transporting a patient using compressed gas, keep the cylinder secured in the holder found on the patient stretcher, wheelchair, or in a portable tank carrier. **NEVER** put the cylinder in the bed with the patient.
3. When transporting cylinders, keep them upright in the holder approved for this purpose.
4. Make sure the regulator is securely attached to the cylinder.
5. Do not carry or hold the cylinder by the regulator.
6. If a small (size E or D) cylinder must be transported by hand, **always use both hands.** One hand must firmly hold the yoke or neck and the other hand must hold the body or base of the cylinder.

**CHS has a policy on the safe use of compressed gases. It is found in the Safety Management Program Manual on Synapse. Go to the manual and review the CHS Policy 5.10. Ask your manager if you have any questions.**

# JOB AID

## Department Specific Information

1 ***Where is the Safety Management Program Manual located in your department?***

_____

2 ***Where can you find the CHS policy on the safe use of compressed gases?***

_____
_____

3 ***List ways to safely store compressed gases.***

_____
_____
_____

4 ***What makes a compressed gas cylinder dangerous?***

_____
_____
_____

5 ***How do you transport cylinders of compressed gas?***

_____
_____
_____

# Posttest

***Name:*** _____

***Date:*** _____

**Circle the correct answer.**

1. **True or False (Circle One)**

   If a compressed gas cylinder is damaged, it may act as a "missile" and hurt you if you get in its path.

2. **If I want to review the CHS Policy 5.10 on Compressed Gases, I will look in the:**

   a. Exposure Control Plan
   b. Hazard Communication Plan
   c. Safety Management Program Manual on Synapse

3. **How will cylinders be stored?**

   a. In a permanent holder or carrier
   b. Chained to an area of a room
   c. Lying on the floor of the storage room
   d. a and b
   e. a and c

4. **True or False (Circle One)**

   One hand must firmly hold the yoke or neck and the other hand must hold the body or base of the cylinder, when transporting E cylinders of oxygen by hand.

5. **When transporting a patient, how must the cylinder be carried?**

   a. In a portable carrier secured in a holder found on the patient's stretcher, wheel chair, or in a portable cylinder carrier
   b. In an employee's hands
   c. In the bed with the patient
   d. b and c

6. **True or False (Circle One)**

   When removable caps are provided by the supplier for valve protection, the caps must be kept on the cylinders when moved.

7. **Safety mechanisms exist to ensure oxygen regulators will only fit an oxygen tank. These safety features include**:

   a. Pin Index Safety System
   b. Diameter Index Safety System
   c. Color of the tank and regulator
   d. Both A and B

8. **True or False (Circle One)**

   No part of any compressed gas cylinder may be subjected to a temperature above 125 degrees Fahrenheit. Keep compressed gas cylinders away from heat sources.

9. **True or False (Circle One)**

   Before attempting to connect a cylinder to a system, the contents must be identified. To identify the contents of a cylinder, you must not rely solely on the color.

10. **True or False (Circle One)**

    Pressure reducing regulators must always be used when withdrawing the contents of the cylinders because such devices deliver a constant safe working pressure.

11. **True or False (Circle One)**

    Compressed gases are to be handled by experienced and properly instructed personnel only.

12. **Cylinders must be kept in what position?**

    a. On their side at all times
    b. Upright
    c. Leaning against a wall

**Score: _____**

**Manager's Initials: _____**