

Safety Instructions for Compressed Gas Cylinders





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Purpose

The purpose of this instruction is to train on how to work with compressed gas cylinders and to outline safety points to prevent any accidents.

Application

These instructions apply to all compressed gas cylinders used at the Faculty of Medicine, and familiarity with these instructions is mandatory for all individuals who use these cylinders and those who are directly or indirectly involved in their storage and transportation.

Types of Gases

Gases are classified into two main groups based on their usage:

- **Industrial Gases:** These gases are typically used in research laboratories and training workshops and are usually charged at a pressure of 175 bar.
- **Medical Gases:** These are gases of a specified purity intended for medical purposes, such as oxygen cylinders, anesthetic gases, and carbon dioxide, which are used for effective patient care.

Hazards Associated with Gases

- 1) Suffocation due to displacement of oxygen in the air.
- 2) Explosion and fire due to heating or impact.
- 3) Chemical hazards related to the nature of the gas during leakage or sudden release of large volumes of gas.





Hazard Groups for Gases

Gases can be categorized into one of the following hazard groups based on their nature:

- **Inert or Asphyxiating Gases:**

These gases do not react with other materials, but they are considered asphyxiants because if a leak occurs, they replace the oxygen in the air and can cause suffocation. Examples include nitrogen and carbon dioxide.

- **Flammable Gases:**

These gases ignite spontaneously upon contact with air. Examples include silane and phosphine.

- **Toxic Gases:**

These gases can cause harm, injury, or death even in low concentrations upon contact with skin or inhalation. Examples include carbon monoxide, chlorine, ammonia, and phosphorous.

- **Corrosive Gases:**

These gases react with other materials and cause specific chemical reactions or destruction. They can harm human tissue. Examples include chlorine, carbon dioxide, and sulfur.

- **Oxidizing Gases:**

These gases do not burn by themselves but promote combustion. They significantly enhance fire in the presence of a spark or fuel source. Examples include oxygen and nitrous oxide (N_2O).

- **Combustible Gases:**

These gases burn when mixed with an oxidizer and exposed to an ignition source. Examples include acetylene and propane.

Main Components of a Cylinder

The main components of a cylinder include the body, valve, regulator (pressure reducer), manometer, safety cap, and connecting hose.

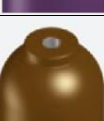
Material of Cylinders

Typically, the material of the cylinders is steel, manufactured in open or electric furnaces. The uniformity of material, thickness, and surface throughout the length of the steel sheet is very important.



Color of Cylinders

According to international standards, the color of each cylinder is selected based on the gas contained within it. This is very useful for identifying the type of gas inside. According to the national standards of Iran, the coloring of the cylinders must comply with the table below.

Color of Cylinder		Chemical Formula	Gas Name
white		O_2	Oxygen
Blue		N_2O	Nitrous Oxide
Gray		CO_2	Carbon Dioxide
Purple		C_2H_4	Ethylene
Brown		He	Helium
Black		N_2	Nitrogen
White and Gray		O_2+CO_2	Oxygen and Carbon Dioxide
White and Brown		O_2+He	Oxygen and Helium



Identification Label for Cylinder Contents

The contents of the compressed gas cylinder must be clearly marked so that it can be easily and quickly identified by the user. Therefore, all gas cylinders must have an identification label containing the following information:

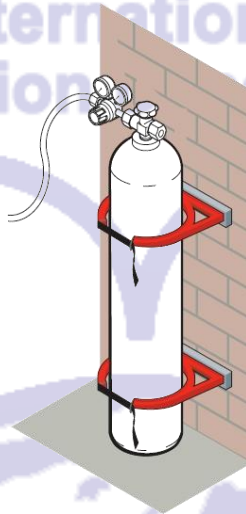
- 1) Name of the gas in the cylinder
- 2) Name of the manufacturer
- 3) Capacity in volume
- 4) Net weight
- 5) Date of cylinder testing
- 6) Hazard symbols and safety-related phrases

Conditions and Use of Cylinders

Users who handle compressed gas cylinders in any way must pay careful attention to the following points:

- 1) Read the Safety Data Sheet (SDS) specific to the gas before using it.
- 2) Be aware of the meaning of the hazard labels on gases.
- 3) Ensure that personal protective equipment is available to avoid inhalation or contact with skin and eyes. Study the method of installing the regulator on the cylinder or consult an expert for guidance.
- 4) Emergency showers and eyewash stations should be available near the cylinder usage area.
- 5) Immediate and emergency treatment including first aid should be readily available.
- 6) Do not open the cylinder valves suddenly or quickly, as sudden pressure release may damage the regulator.
- 7) When opening the cylinder valve, never position yourself in front of the pressure gauge and stay as far away as possible.
- 8) Cylinders that are empty or not in use should be closed and have the safety cap installed.
- 9) Do not apply excessive force when closing the valve.
- 10) Never lubricate the cylinder valves with oil.

- 11) Cylinders should be kept upright and secured with chains or straps to a support to prevent them from falling.



- 12) Before installing the regulator on the cylinder, ensure it is in good condition.
13) Never open or close the cylinder valve with a wrench; use the proper tool instead.
14) Ensure that gas hoses are not kinked.
15) Check that the gas hoses are free from cuts or deterioration.
16) Ensure that gas hoses do not obstruct pedestrian traffic.



- 17) Make sure that gas hoses are not placed under heavy objects.
18) Both ends of the hose must be secured with appropriate clamps; do not use wire instead of clamps.
19) Avoid using excessively long hoses.
20) To check for gas leaks, test the connections with soap and water and avoid using flames or direct heat for leak detection.
21) Never use a flame or direct heat on the cylinder or its components.
22) Only use compressed gas cylinders if you possess the necessary skills and knowledge; otherwise, entrust the task to trained and experienced personnel.

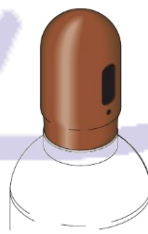


Storage and Handling of Cylinders

- 1) **Separation of Full and Empty Cylinders:** Full and empty cylinders must be stored separately.
- 2) **Vertical Storage:** Cylinders should be kept in an upright position and secured with chains in a safe manner.
- 3) **Ventilation:** The storage area for cylinders must be well-ventilated.
- 4) **Protection from Excessive Heat:** Cylinders stored outdoors should not be exposed to excessive heat and temperatures.
- 5) **Accessibility for Emergencies:** The storage location should allow for easy removal of cylinders in the event of a fire.
- 6) **Distance Between Different Gases:** Cylinders containing different gases should be kept at least 3 meters apart.
- 7) **Elevated Storage Platforms:** Outdoor cylinder storage must be on a raised platform with surrounding walls made of mesh fencing, and a shelter should be placed on top.
- 8) **Weather Protection:** Cylinders stored outdoors must be protected from weather conditions such as wind, rain, and snow.
- 9) **Avoidance of Flammable Materials:** Cylinders should not be stored near flammable materials, such as petroleum products, corrosive chemicals, or combustibles.
- 10) **No Smoking Signs:** A sign prohibiting smoking and open flames or sparks must be displayed in the storage area.
- 11) **Temperature Control:** The storage temperature should not exceed 65 degrees Celsius.

Handling and Transportation of Cylinders

- 1) **Remove Regulators:** Before transporting cylinders, remove their regulators and install the safety cap on the cylinder.



- 2) **No Rolling:** Never attempt to roll the cylinders for transportation.
- 3) **Avoid Contamination:** Do not move oxygen cylinders with hands that are contaminated with oily substances.



- 4) **Use Appropriate Trolleys:** Use suitable wheeled equipment for transporting cylinders.
- 5) **Wear Safety Shoes:** It is advisable to wear safety shoes while transporting cylinders to prevent foot injuries in case a cylinder falls.
- 6) **Trained Personnel Only:** The handling and transportation of cylinders should only be performed by trained personnel.
- 7) **Manual Movement for Short Distances:** For short distances, tilt the cylinder and use hand movements to rotate and maneuver it on its base.

Information Related to Regulators

- ✓ **High Pressure:** Compressed gas cylinders are under high pressure, and direct use of the gases contained within the cylinder is not feasible. Regulators reduce the output pressure from the cylinder.
- ✓ **Control of Pressure:** Regulators allow users to maintain control over the cylinder pressure and to adjust the output pressure according to their needs.
- ✓ **Specific Regulators for Different Gases:** Different gases have their specific regulators.
- ✓ **Do Not Use for Other Gases:** Never use regulators for gases other than the one for which they were designed and manufactured.
- ✓ **Consult Experts:** Before using regulators, especially if you are not familiar with their operation and usage, consult experienced professionals and study their safety instructions.

Connecting the Regulator to the Cylinder

- 1) **Attach the Regulator:** Secure the regulator to the cylinder and tighten the cylinder's safety nut using the appropriate wrench.
- 2) **Close the Regulator Before Opening:** Before opening the cylinder valve, ensure that the regulator is fully closed. To do this, turn the regulator adjustment screw all the way clockwise.
- 3) **Open the Cylinder Valve Slowly:** While the regulator adjustment screw is fully turned counterclockwise, place both hands on the cylinder valve and slowly open it, allowing the pressure inside the regulator to gradually increase.
- 4) **Open the Cylinder Valve Fully:** When the manometer needle indicates the maximum pressure within the cylinder, you can fully open the cylinder valve.
- 5) **Set Desired Output Pressure:** Turn the regulator adjustment screw clockwise to set the desired output pressure on the manometer.

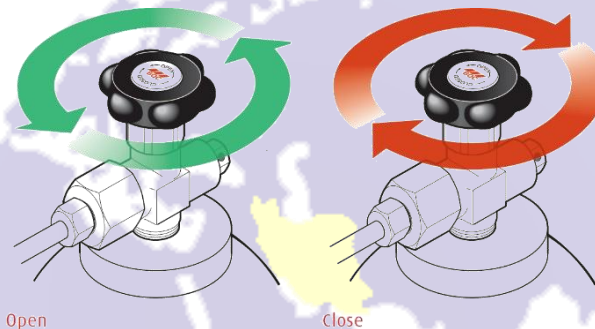


Detaching the Regulator from the Cylinder

- 1) Close the cylinder valve.
- 2) The gas remaining inside the regulator must be vented. To do this, turn the regulator adjustment screw clockwise until no pressure is indicated on the regulator.
- 3) After venting the gas and reaching a pressure of zero, turn the regulator adjustment screw counterclockwise to its lowest setting.
- 4) Completely disconnect any low-pressure equipment that is attached to the high-pressure gas cylinder.
- 5) Use the appropriate wrench to detach the regulator from the cylinder.

Information Related to Cylinder Valves

The cylinder valve is one of the important components of the cylinder and plays a significant role in its safety. The cylinder valve is opened using a manual handwheel or lever.



- ✓ The cylinder valve must never be removed or tampered with.
- ✓ Repairing the cylinder valve is a very dangerous action.



- ✓ The valve opens by turning the lever counterclockwise.
- ✓ The valve closes by turning the lever clockwise.



Pressure Measurement Units

The unit of pressure in the International System of Units (SI) is Pascal, represented by the symbol Pa. One Pascal is defined as the pressure resulting from a force of one newton applied over an area of one square meter.

Bar

One bar is equivalent to 100 kilopascals and differs from atmospheric pressure by about one percent. This unit is commonly used in European countries.

Conversion: 1 bar=100,000 Pa 1 bar=100,000 Pa

psi

psi (pounds per square inch) is a common unit of pressure in the English system.

Conversion: 1 psi=6,894.8 Pa 1 psi=6,894.8 Pa

1 bar=14.5 psi

1 bar=14.5 psi

Cylinder Leakage

Regulators, cylinder valves, and piping systems must be resistant to gas pressure and must not leak. You can check the tightness of connections using a suitable solution, such as soapy water, to ensure there is no gas leakage.

Necessary Actions for a Leaking Cylinder

- 1) A cylinder with a leak should not be used.
- 2) If you notice gas leaking from the cylinder, immediately close the cylinder valve.
- 3) Transfer the cylinder to an open area away from any heat sources or sparks.
- 4) If moving the cylinder outside its storage area is not feasible, prohibit access to the area and block off entrances.
- 5) Notify safety and fire protection officials about the leak.
- 6) After the gas is vented by firefighting personnel, attach a "Cylinder is Not Usable" label to the cylinder until necessary repairs are made.



Cylinder Repairs

Any repairs to cylinders by unauthorized personnel are prohibited.

Attach a tag indicating the required type of repair to the cylinder and send it to certified repair centers.

Control Inspections

- ✓ **Leakage Testing:** Ensure there are no leaks.
- ✓ **Visual Safety Inspection:** Check for physical damage.
- ✓ **Safety Cap Presence:** Confirm the safety cap is in place during transportation.
- ✓ **Label Information:** Ensure the cylinder has the proper information label.

Periodic Testing and Inspections

All gas cylinders must be inspected internally and externally, and a hydraulic pressure test must be conducted every 5 years by a qualified authority accredited by the standards organization.

References

- 1) Iran National Standard 314: Medical Gas Cylinders for Medical Use - Marking for Identification of Cylinder Contents.
- 2) Iran National Standard 7566: Gas Cylinders - Safe Handling - Procedure Guidelines.
- 3) Iran National Standard 3241: Medical Oxygen - Characteristics and Testing Methods.
- 4) Educational Articles: Available on the Aryan Gas website.
- 5) BOC Guidelines for Gas Cylinder Safety