



ATMOSPHERIC PRODUCTS AND SERVICES (APS)

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SafetyAlert-21

Safe Handling Procedures for Medical Oxygen Cylinders and the Use of Regulating Equipment

General Warning

Medical oxygen systems and regulating equipment should be used only by persons who have been properly trained in administering oxygen. This equipment is intended for use as directed or prescribed by a medical professional. Use only therapeutic (medical) grade oxygen with medical oxygen regulating equipment.

Note: Breathing of oxygen in high concentrations for long periods of time or at elevated pressures may be harmful

Safety Considerations

Fire is the primary hazard associated with gaseous oxygen. Combustion results from the interaction of three elements—a fuel, an oxidizer (oxygen), and an ignition source. Oxygen itself does not burn, but supports or vigorously accelerates the combustion of other materials. Oxygen at high concentrations or at elevated pressures increases the rate of combustion and can promote combustion of materials that do not normally burn in air at atmospheric pressure.

Keep all foreign materials, especially other gases, dirt, rust, oil, grease, hydrocarbons, and other potential fuel or ignition sources, away from the oxygen regulator and the cylinder valve. Ignition energy may be supplied by the sudden compression of oxygen in a line or equipment when the cylinder valve is opened too quickly; always open oxygen cylinder valves slowly.

Cylinder Procedures

Handling

1. Avoid dragging or sliding cylinders, even for short distances. Cylinders should be moved by using a suitable hand truck.
2. Never drop cylinders or permit them to strike each other violently.
3. Cylinders equipped with valve protection caps should have the valve protection cap left in place until the cylinder has been secured against a wall or bench, placed in a cylinder stand, or placed on a cylinder cart and is ready to be used. Cylinders should always be secured when in use.

4. Never tamper with safety devices in valves or on cylinders.
5. Never permit oil, grease, or other readily combustible substances to come in contact with oxygen cylinders, valves, or regulators.
6. When returning empty cylinders, close the valve before shipment. Leave some positive pressure in the cylinder. Replace any valve outlet and protective caps originally shipped with the cylinder. Mark and label the cylinder EMPTY. Do not store full and empty cylinders together.
7. Refer to APS SafetyAlert-10 for additional information concerning safe handling of compressed gas cylinders.

Leaks

In spite of precautions taken by the compressed gas manufacturer, leaks may occasionally occur at the cylinder valve. Cylinders and system connections should be checked with commonly accepted solutions suitable for leak-checking oxygen systems. Move a leaking oxygen cylinder to an isolated, well ventilated, preferably outdoor area away from combustible materials, and post signs such as "Leaking Oxygen Cylinder" or "No Smoking, No Open Flames."

Storage

1. Always store cylinders in the upright position. Cylinders should be assigned to a definite area for storage. Segregate full and empty cylinders in their storage area. The area should be dry, cool, well ventilated, and preferably fire resistant. Keep cylinders protected from excessive temperatures by storing them away from radiators or other sources of heat. Cylinders may be stored in the open, but should be protected from extremes of weather and from damp ground to prevent rusting. In general, cylinders should be protected from theft or vandalism while in storage.
2. Smoking or open flames should be prohibited in oxygen cylinder storage areas.
3. Do not store oxygen cylinders and flammable gas cylinders in the same room unless: a) state and local regulations allow such storage, and b) there



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is adequate separation by distance or fire-resistant partitioning walls.

Use

1. Know and understand the properties, uses, and safety precautions for oxygen before using the gas and/or associated equipment.
2. The cylinder decal or label is the correct way to identify the gas contained in a cylinder. Color coding of cylinders is an identification method used for the convenience of the cylinder gas supplier only.
3. Do not use cylinders as rollers for moving material or other equipment.
4. Never attempt to mix gases in a cylinder or to refill an oxygen cylinder.
5. Never use oxygen as a substitute for compressed air.
6. No part of a cylinder should be subjected to a temperature above 130°F (54°C). Prevent sparks or flames from coming in contact with cylinders. Do not permit cylinders to come in contact with electrical apparatus or circuits.
7. Use regulators and pressure relief devices when connecting to circuits having lower pressure service ratings. Open the cylinder valve slowly before adjusting the pressure on the regulator.
8. Never use medical oxygen at full cylinder pressure. Always use medical oxygen with appropriate regulating equipment.
9. Always open an oxygen cylinder valve slowly.
10. Valves should be closed on cylinders and all pressure released from equipment connected to the cylinder any time an extended nonuse period is anticipated.

Table 1 Oxygen Properties

Molecular Weight	32.00
Boiling Point @ 1 atm	-297.3°F (-183.0°C)
Freezing Point @ 1 atm	-361.8°F (-218.8°C)
Critical Temperature	-181.1°F (-118.4°C)
Critical Pressure	737 psia (50.1 atm)
Density, Liquid @ B.P., 1 atm	71.23 lbs./cu. ft.
Density, Gas @ 70°F (21.1°C), 1 atm	0.08279 lbs./cu. ft.
Specific Gravity, Gas (Air=1) @ 68°F (20°C) 1 atm	1.10
Specific Gravity, Liquid @ B.P., 1 atm	1.14
Specific Volume @ 68°F (20°C), 1 atm	12.04 cu. ft./lb.
Latent Heat of Vaporization	2934 Btu/lb. mole
Solubility in Water @ 77°F (25°C), 1 atm	3.16% by volume

11. Wrenches should not be used on valves equipped with a handwheel. If the valve is faulty, attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.
12. Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder filled without the consent of the owner is a violation of Federal law.
13. If a cylinder protective cap, on cylinders so equipped, is extremely difficult to move, do not apply excessive force or pry the cap loose with a bar inserted into the ventilation openings. Attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.
14. Refer to the APS publication entitled "Medical Gases and Equipment-Safety and Technical Information" for additional information on characteristics and safe handling of medical gases.

Positioning and Set Up of Cylinder and Regulator Systems

The following are considered proper steps for establishing medical oxygen service:

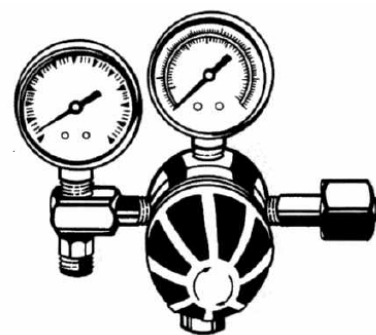
1. **Position the Cylinder** – Cylinders must be stood upright and secured to a wall or a support or be in a cylinder cart. Cylinders shall not be fastened to any bed.

2. **Identify the Regulator** – Regulators may be of three types:

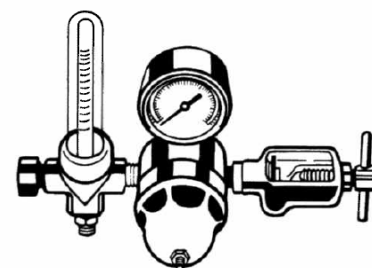
Bourdon Gauge (Figure 1)
Back-Pressure Compensated (Figure 2)
"Pre-Set" (Figure 3)

Check the label and the gauge (gauges) on the regulator to make sure it (they) is (are) properly marked for oxygen service.

Caution: Select a back-pressure compensated regulator flowmeter for use with nebulizers and humidifiers.



**Figure 1
Bourdon Gauge-Type Regulator**



**Figure 2
Back-Pressure Compensated
Regulator/Flowmeter**

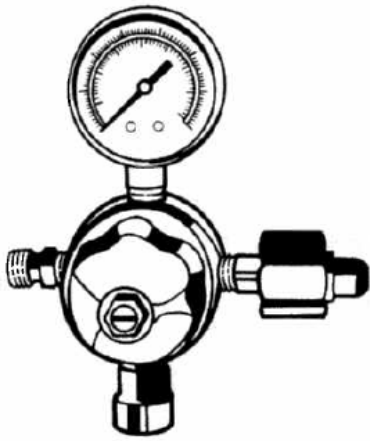


Figure 3
Pre-Set Regulator

Do not use a Bourdon gauge-type regulator with accessories that cause restriction to the oxygen flow, such as nebulizers and humidifiers. Flow restrictions cause erroneous readings with Bourdon gauge-type regulators. Correct readings are attained by using back-pressure compensated regulator/flowmeter combinations.

3. **Inspect the Regulator** – Inspect the overall condition of the regulator for any signs of damage. Carefully check the inlet fitting and porous filter and the outlet fitting. If there are any signs of damage or contamination, such as foreign material inside the regulator, return it to your local APS office or to an authorized APS distributor or repair center. Consult the Yellow Pages for the office nearest you.

Warning: Do not attempt field repairs or make modifications to any oxygen regulator.

4. **Inspect the Cylinder Valve** – Return any oxygen cylinder with a damaged valve or one that shows any signs of contamination to the supplier. If the valve is undamaged, point the outlet away from yourself or any other person, stand to one side and “crack” (open slightly) the valve and then close. Cracking the valve blows it clear of particulate matter such as

dust. Be sure that all smoking and open flames rules are enforced.

5. **Attaching the Regulator** – Tighten the nut connecting the regulator securely to the cylinder valve.
 - (a) Bourdon Gauge-Type Regulator (Figure 1)—Close the regulator by turning the adjusting knob counterclockwise until it turns freely. The cylinder valve may then be opened.
 - (b) Back-Pressure Compensated Regulator/Flowmeter (Figure 2)—Close the needle valve by turning the knob clockwise until it seats, before opening the cylinder valve. Do not apply excessive force; this can damage the needle and its seat.
 - (c) Pre-Set Regulator (Figure 3)—This regulator is usually used where cylinders are located remote from the equipment being used, and is connected by pressure tubing or hose. Intermittent Positive Pressure Breathing devices or a respirator where flow controls are already provided are examples of equipment where pre-set regulators are used. Be sure valves on auxiliary equipment are closed before opening the cylinder valve. Be certain that auxiliary equipment is rated for use at 50 psig.

6. **Attaching Prescribed Dispensing Devices**—Connect all equipment to the oxygen supply system before opening the cylinder valve.

7. **Opening a Cylinder Valve with a Regulator Attached**—Figure 4 shows how to position yourself when opening a cylinder valve. Always stand to the side of the regulator away from the front of the gauges and adjusting knob. Place both hands on the cylinder valve. Open it slightly and very slowly until the cylinder pressure builds on the gauge and the needle stabilizes. The cylinder valve should then be opened to the full limit of its travel, which will back seat the cylinder valve.

8. **Leak Checking**—Check entire system for leaks. Refer to the section on leaks.

Flow Adjustments

1. **Pre-Set Regulator**—No adjustments are necessary since this device is specifically designed for use with equipment which has flowmeters or valves to control the oxygen flow.
2. **Bourdon Gauge-Type Regulator**—Turn the adjusting knob clockwise to increase the flow rate. Decrease the flow or stop the flow completely by turning the adjusting knob counterclockwise.

Caution: Check for the unrestricted flow of oxygen to the dispensing device by listening or feeling for the flow.

3. **Back-Pressure Compensated Regulator/Flowmeter**—Turn the needle valve counterclockwise to decrease or stop the flow entirely.

Note: The flow rate is read at the center line of the ball float in the flowmeter.

Shutdown or Cylinder Replacement

1. Close the cylinder valve. Turn clockwise until the valve is tightly seated.
2. Vent (or bleed) pressure from the complete system.
3. Close the flow rate adjustment according to the type of regulator.
 - a. Turn the adjusting knob counterclockwise on the Bourdon type until it turns freely.
 - b. Turn the needle valve clockwise to the limit of its travel on the back-pressure compensated type.
4. Disconnect the regulator from the cylinder and replace the cylinder valve cap.
5. Protect the regulator inlet and outlet fittings from damage or contamination by replacing the plastic covers.

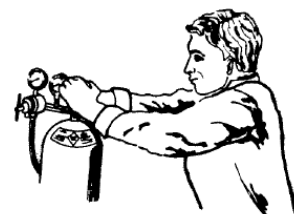


Figure 4

Information Sources

- Compressed Gas Association
1725 Jefferson Davis Highway, Suite 1004
Arlington, VA 22202-4102
Phone: 1-703-412-0900
- National Fire Protection Association
1 Batterymarch Park, P.O. Box 9101
Quincy, MA 02269-9101
Phone: 1-800-344-3555

Emergency Response Telephone Numbers

USA

CHEMTRAC

1-800-424-9300 (Toll Free in the U.S., Canada, and U.S. Virgin Islands)
703-527-3887 for calls originating elsewhere (Collect calls are accepted)

CHEM-TEL, INC.

1-800-255-3924 (Toll Free in the U.S., Canada, and U.S. Virgin Islands)
813-248-0585 for calls originating elsewhere (Collect calls are accepted)

INFOTRAC

1-800-535-5053 (Toll Free in the U.S., Canada, and U.S. Virgin Islands)
352-323-3500 for calls originating elsewhere (Collect calls are accepted)

3E COMPANY

1-800-451-8346 (Toll Free in the U.S., Canada, and U.S. Virgin Islands)
760-602-8703 for calls originating elsewhere (Collect calls are accepted)

NATIONAL RESPONSE CENTER (NRC)

Call NRC (24 Hours)

1-800-424-8802 (Toll Free in the U.S., Canada, and U.S. Virgin Islands)
202-267-2675 in the District of Columbia

MILITARY SHIPMENTS

703-697-0218 Explosives/Ammunition Incidents (Collect calls accepted)
1-800-851-8061 All other dangerous goods incidents

NATIONWIDE POISON CONTROL CENTER (United States Only)

1-800-222-1222 (Toll Free in the U.S.)

CANADA

CANUTEC

613-996-6666 (Collect calls are accepted)
*666 Cellular (In Canada only)

Visit Web Site: www.apsusa.biz for further information

or

Call 410-833-7170

or

Ask your local sales representative