Saint Mary's University

Electron Microscopy Centre

Title: **SAFELY USE OF GAS REGULATOR**

Equipments: 1. **COLD STAGE OPERATING ON LEO 1450VP**
2. SPUTTER COATER -- GOLD

Revision: **1.0**

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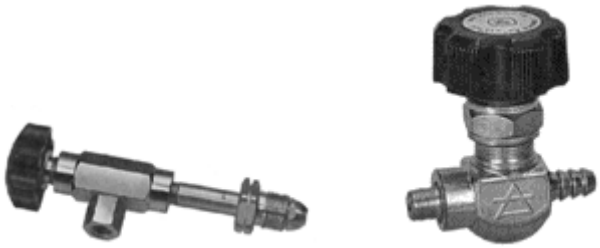
Introduction

There are typically a wide variety of gas regulators in average chemistry, physics and biology labs. The majority of these are single stage and two stage regulators.

The advantage of a two stage regulator is that the pressure flow remains consistent until the tank is nearly empty. Therefore, you might want to use a double stage regulator on a gas chromatograph (GC), but for a typical Schlenk line a single stage regulator would suffice.

Two other common types of "regulators" that you might encounter are actually called **flow control valves**. Unlike a regulator, these DO NOT control pressure, only flow. However, they permit one to easily dispense gas from a cylinder. As they lack gauges, be extremely cautious when hooking a flow valve up to a vacuum line!!

The manual flow control valve shown below on the left is usually used on small cylinders (carbon dioxide, ethylene etc.) and the one on the right is typically used on lecture bottles. Small single and double stage lecture bottle regulators are also available.



Finally, note that you should **NEVER** use grease or oil on a regulator. Not only will it gunk up the inside and contaminate your reaction system, but these organic materials can react with the gas being dispensed. **Never** use an oxygen regulator for other gases. Cross-contamination of internal parts (especially with grease or oil) could cause a rapid oxidation and fire.

How to select a proper gas regulator

Not all regulators can be used on all cylinders. For example, flammable gases such as hydrogen require brass fittings. The Compressed Gas Association (CGA) has devised a system that ensures accidental mix-ups can not occur. Each cylinder and regulator have connection fittings that are designated by a CGA number. Below are some common CGA numbers. High pressure tanks or lecture bottles require different fittings:

Gases	CGA Connection #
Carbon dioxide	320
Boron trifluoride, hydrogen chloride, hydrogen bromide, hydrogen iodide, hydrogen sulfide, silicon tetrafluoride	330
Carbon monoxide, ethylene, hydrogen, hydrogen selenide	350
Acetylene, allene, butadiene, butane, butenes, cyclopropane, dimethylether, methane, propane, propylene, vinyl methyl ether	510
Oxygen	540
Argon, nitrogen, helium, noble gases	580
Air (industrial grade)	590
Boron trichloride, chlorine, nitric oxide, nitrogen dioxide, nitrogen trioxide, sulfur dioxide, phosphorous pentafluoride, many halocarbons	660
Anyhdrous ammonia	705

CGA numbers are typically (but not always) stamped on the regulator just above the threads of the cylinder connection. Some will even state specifically which gas(es) for which they can be used. **It is a very bad idea to alter a regulator or use an adapter to "make" a regulator fit a tank for which it was not designed.** This kind of deliberate tampering with a safety feature could lead to a serious accident.

Flammable gases have reverse threads meaning that the connection is **tightened** by turning the nut **counterclockwise**. You can always tell a reverse thread connection because the nut that you tighten has a line inscribed around its circumference. Compare the nut on the manual flow control valve (reverse threaded) with the one on the double stage regulator (regular thread) shown above.

Installing and Using a Regulator

1. Make sure your cylinder is properly secured, that you have the correct regulator and that you are aware of any special hazards of the gas you are working with.
2. Remove the cylinder valve cap (counterclockwise). Place it somewhere nearby.
3. Some regulators (on lecture bottles and certain corrosive gases) require a Teflon or lead washer to be inserted between the tank outlet and regulator. Check to see if this is required before continuing.
4. Make sure that the regulator outlet valve (**A**) is shut.

Screw it clockwise until it seats. Do not over-tighten it or you can damage the valve seat.

5. Make sure that the regulator control valve (**B**) is shut. Screw it **counterclockwise** until it is almost completely unscrewed. If you unscrew it completely, just put it back in.
6. Screw the regulator onto the tank by hand until it is almost finger tight. Some people like to use Teflon tape on this connection, but that's generally not a good idea. Bits of Teflon tape can get blown into the regulator, causing a leak, valve malfunction or erroneous reading.
7. What you do next depends on the kind of gas you are working with and whether you need to exclude air from the gas line you're connecting to.

   For nitrogen and argon cylinders:

   - If you don't need to purge out the "dead volume" of air in the regulator body, simply tighten the regulator firmly with a wrench (use the correct tool for the job, not pliers!).
   - If you need to exclude air from your line then you can purge out the "dead volume" using the following technique. With the regulator on finger tight, open the tank valve until gas just begins to flow. Once the dead volume is purged (2-4 seconds) and with the tank still open a minimum amount, tighten the regulator firmly with a wrench. **Note**: Do not attempt this procedure without the direct supervision of someone who is experienced in the technique. Do not use this technique on an unsecured cylinder, for any other gases or in an unventilated area!!

   For corrosive or reactive gases:

   - Make sure you are using the proper regulator (typically these will be made of stainless steel or Monel).
   - Tighten the regulator firmly with a wrench (use the correct tool for the job, not pliers!).
   - Purge the regulator with an inert dry gas or evacuate the system (depending on the exact set-up). Specific instructions for this will vary depending on what you need to do so consult your instructor.
   - Be sure to install some kind of suck-back trap after the regulator or at least use clear Tygon tubing so that the backflow of corrosive reaction mixtures into the regulator and cylinder can be avoided.

   For flammable gases:

   - If you are using acetylene be **certain** that you are using an acetylene regulator with proper fittings. Alloys containing copper or silver can cause explosions when used with acetylene! Also be certain that acetylene won't contact mercury in your system (in a mercury bubbler, for example) and that you are properly venting and flaring off acetylene from your system.
   - Ideally, ground the system to avoid static discharges.
   - Tighten the regulator firmly with a wrench (use the correct tool for the job, not pliers!).

- If necessary, follow the purge instructions for corrosive or reactive gases as shown above.

8. Open the tank valve slowly (counterclockwise). Watch the tank pressure on the regulator (**C**).
9. Slowly turn the regulator control valve (**B**) until the regulator pressure (**D**) is at the desired level.
10. Open the regulator outlet valve (**A**). You can regulate flow with this valve, but the ultimate pressure depends on the setting of the regulator control valve!
11. Check your system for leaks using Snoop (a commercial product) or some soapy water. Snoop is preferred since it leaves no residue. If you find leaks and tightening the connections does not help ask your instructor for assistance.

Reminder: Do not use Teflon tape on Swagelock ferrule compression fittings.

Disconnecting a Regulator

1. Shut the tank valve on the gas cylinder.
2. Slowly open the outlet valve (**A**) on the regulator.
3. Watch the pressure gauges **C** and **D** drop to zero.
4. Open the regulator control valve (**B**) (turn it clockwise) to ensure that all pressure has been released.
5. If you were using a corrosive gas, purge the system with a dry inert gas.
6. Using a wrench (not pliers!) disconnect the regulator from the gas cylinder. Replace the protective cylinder cap immediately.
7. If your regulator was used with a corrosive gas, purge it again with dry air or nitrogen in the hood for several minutes.
8. If your cylinder is empty, it must be properly labeled and then returned to the manufacturer or distributor (in many cases, this is your school or company stockroom). Do not store empty gas cylinders in the laboratory.

Reminder: Make sure the tank valve is closed whenever you are not dispensing gas through the regulator.

Appendix:

Aldrich Chemical Technical Bulletin: Gas Regulators - Selection and Installation.

Technical Bulletin
AL-151

Gas Regulators
Selection and Installation

revised 3/97
2 pages

Lecture bottle regulator specifications:
CGA 180 inlet connection
Needle valve with 1/4 in. NPTM outlet
Triple-inlet filters
Maximum inlet pressure: 3000 psig
Operating temperature: -40 to 140°F

Figure 1. Chromeplated, brass body regulators for use with noncorrosive compressed gases and low pressure liquefied gases.

Figure 2. 316 stainless steel body regulators for use with corrosive and high purity gases.

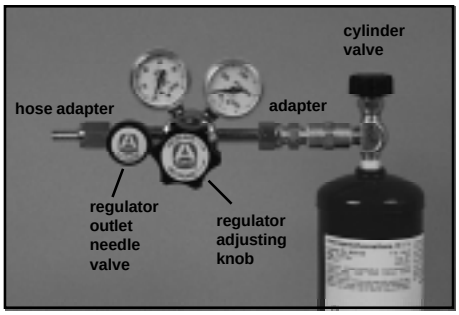


Figure 3. Typical regulator assembly needed for a low-pressure, flat-bottom cylinder. The special adapter can be clearly seen between the stainless steel regulator and the cylinder valve.

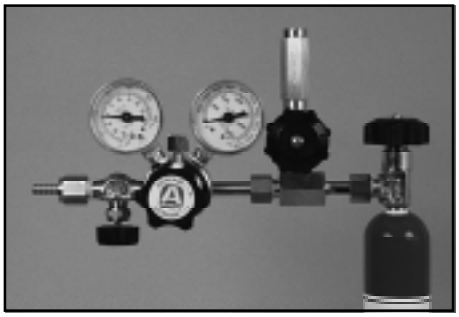


Figure 4. Use of the Aldrich T-purge assembly and Bonnet vent with corrosive or high-purity gases packaged in lecture bottles.

Aldrich lecture bottle and specialty gas regulators are designed for use with dry (anhydrous) gases at a normal operating temperature of 70°F (21°C) and maximum inlet pressure of 3000 psig. Certain gases will hydrolyze in the presence of moisture to form corrosive products that can impair regulator operation and cause failure. It is essential that system lines and regulators be purged with *dry* inert gas before and after use with corrosive gases.

NOTE: ALL OPERATIONS INVOLVING HAZARDOUS GASES MUST BE PERFORMED IN A CHEMICAL FUME HOOD. THE INFORMATION PROVIDED IN THIS BULLETIN SHOULD SERVE AS A GUIDE FOR THE SAFE OPERATION OF ALDRICH REGULATORS WITH SPECIALTY GASES.

Regulator Selection

Recommended regulators and control valves for use with Aldrich gas products are specified in the entry for each gas listing in the chemical section of the Aldrich Catalog/ Handbook and on the product label. Do not use Aldrich gas regulators on cylinders that exceed 3000 psig.

Regulators for oxygen service should never be used with other gases. This rule applies for all oxidizing gases. Cross contamination of internal parts may result in rapid oxidation and fire.

Lecture bottle regulators are lightweight and ultracompact (see Fig. 1 and 2). A special brass CGA cylinder adapter is included to connect regulators with a CGA 180 inlet to the 1/4 inch pipe threads on flat-bottom cylinders (Fig. 3).

Regulator Installation

1. Inspect the regulator and cylinder valves for damage or contamination. Never use dirty or damaged equipment.

2. Secure the gas cylinder to prevent accidental tipping and valve damage. A lecture bottle stand is recommended for lecture bottle gases. A ring stand with suitable clamps will secure flat-bottom liquefied-gas cylinders.

A. Corrosive gases

1. Install a T-purge assembly, Fig. 4. A CGA 180 Teflon® washer is required at the cylinder outlet valve connection.

2. Attach a stainless steel lecture bottle regulator to the outlet side of the T-purge assembly using a second CGA 180 Teflon washer.

3. Use a Bonnet vent connector to attach tubing to the regulator Bonnet vent. A bonnet vent tube safely routes gas to a chemical fume hood or suitable collection vessel should the regulator diaphragm rupture or fail. Use of the remote Bonnet vent tube is highly recommended for use with hazardous gases.

4. Connect the purge valve on the T-purge assembly to a source of dry, inert gas.

5. Attach the downstream side of the regulator to the reaction vessel or system. A line filter and check valve can be installed between the regulator and vessel. Use of a check valve will protect the regulator from back-pressure damage and back streaming of process gas.

6. Purge the regulator and system lines with dry inert gas. Check all connections for leaks before process gas is introduced.

B. Noncorrosive gases

1. Attach the regulator to the cylinder outlet valve and tighten the regulator inlet nut securely. A CGA 180 Teflon washer is required at this connection.
   NOTE: Liquefied gases are generally packaged in low-pressure cylinders with a 1/4-inch NPT outlet valve connection. Use the adapter provided to attach the regulator to the cylinder, Fig. 4. Wrap the cylinder outlet valve threads with Teflon tape prior to connecting the adapter to ensure a leak-free joint.

Equipment used in this Bulletin

Brass lecture bottle regulator (Figure 1)
Single stage, for use with noncorrosive gases. Compact, chromeplated brass body with CGA 180 inlet connection and needle valve with ¼ in. NPTM outlet. Includes CGA adapter, Z14,730-3. Requires Teflon sealing washer, Z14,699-4. Maximum inlet pressure: 3000 psig. Operating temperature: -40 to 140°F.

Delivery pressure (psig)	Gauge (psig)	Cat. No.
0-100	0-150	**Z14,670-6**
0-15	0-30	**Z14,671-4**

SS lecture bottle regulator (Figure 2)
Single stage, for use with most corrosive and halogenated gases and high-purity applications. 316 SS body and gauges with Teflon seals and inner friction sleeves. CGA 180 inlet connection and needle valve with ¼ in. NPTM outlet. Includes CGA adapter, Z14,730-3. Requires Teflon sealing washer, Z14,699-4. Maximum inlet pressure: 3000 psig. Operating temperature: -40 to 140°F. ⅛ in. 27 NPTF remote bonnet-vent.

Delivery pressure (psig)	Gauge (psig)	Cat. No.
0-15	0-30	**Z14,850-4**
0-50	0-100	**Z14,851-2**

Special brass cylinder adapter (Figure 3)
Used to attach Aldrich regulators to cylinders. ¼ in. NPTF valve outlet and a 180M CGA. **Z14,730-3**

Bonnet vent tube connector (Figure 4)
316 SS. Used to attach vent tube to remote vent fitting found on regulators. ⅛ in. NPTM.

Compression fitting	Cat. No.
¼ in. o.d. tube	**Z17,357-6**
⅛ in. o.d. tube	**Z17,358-4**

Check valve (Figures 6 & 8)
Max. pressure 3000 psig, ¼ in. NPTF to ¼ in. NPTF. Attaches to the outlet side of regulator to prevent back streaming of liquids and gases into regulator or cylinder.

Type	O-ring	Cat. No.
Brass	Viton®	**Z14,684-6**
SS	EPR	**Z14,685-4**
SS	neoprene	**Z14,686-2**
SS	Viton	**Z14,687-0**

Hose adapter (Figure 3)
¼ in. NPTF to ¼ in. i.d. hose. Brass has serrated hose connector; SS has tapered hose connector.

Description	Cat. No.
Brass	**Z14,681-1**
SS	**Z14,683-8**

T-purge valve, 316 SS (Figures 4 & 8)
Installs between lecture bottle and regulator to purge system (including regulator) of air, moisture, or process gas. Reduces corrosion problems caused by gas hydrolysis; extends service life of components. Dry system with inert gas before introducing corrosive gases and again immediately after use. CGA 180 inlet/outlet fittings. Requires Teflon sealing washer, Z14,699-4. 3000 psig service pressure. Diaphragm-seal purge valve with ¼ in. NPTM inlet. Check valve at purge-inlet port to prevent backflow of gas.
Z15,166-1

Regulator Operation

1. Close the regulator by turning the regulator adjusting knob off (counter clockwise). This must be done **before** the cylinder valve is opened.
2. With the regulator turned off (adjusting knob turned fully counter-clockwise) and the regulator outlet needle valve closed (clockwise), open the cylinder valve slowly (counter clockwise), allowing the pressure to rise gradually in the regulator. When the high pressure gauge indicates maximum pressure, open the cylinder valve fully.
   CAUTION: Always close the cylinder valve when leaving the system unattended.
3. Adjust the system pressure by turning the regulator adjusting knob clockwise until the desired pressure is indicated on the low-pressure gauge.
4. Carefully check all system connections for leaks.
5. Adjust the gas flow rate to the system by turning the regulator outlet needle valve (counter clockwise to open).

Regulator Removal

1. Close the cylinder valve.
2. Vent or purge the process gas from the regulator and system. With the regulator outlet needle valve open (counter clockwise), turn the regulator adjusting knob clockwise to release any gas trapped in the regulator. If hazardous gas is present in the system, purge with dry, inert gas. Take appropriate measures to render the purged gas innocuous before venting the gas to the atmosphere.
3. Turn the regulator adjusting knob counter clockwise (off) as far as possible.
4. Disconnect the regulator (and purge assembly) and protect the inlet and outlet fittings from contamination or damage.
5. Replace the cylinder valve cap or plug.

Cylinder & Regulator Assemblies

Figure 5. Installation without regulator, but with hose-barb adapter, for noncorrosive, liquefied gases packaged in low pressure flat-bottom cylinders.

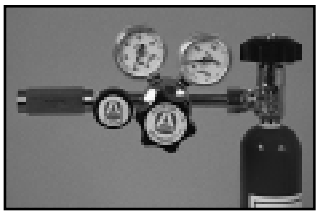


Figure 6. Use of a check valve on the outlet side of the regulator. This valve prevents cylinder suck back and back streaming of process gas, and protects the regulator from back pressure damage.

Figure 7. Use of a control valve, which meters the flow of gas packaged in the lecture bottles when pressure regulation is not required.
WARNING: Gas-control valves do not control pressure in a closed system. A relief valve should be used in such a system to prevent build-up of pressure, which could lead to an explosion, unless vented.

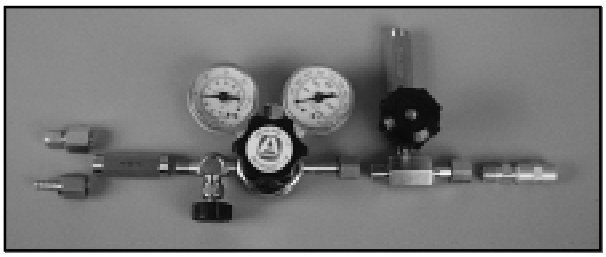


Figure 8. Optional gas-handling accessories. From left to right: tubing connectors (Swagelok® and hose-barb type), check valve, regulator, and T-purge assembly.

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Safetygram #10

Handling, Storage, and Use of Compressed Gas Cylinders

General

As a member of the chemical industry, Air Products is committed to the tenets of Responsible Care® to help guide our performance with respect to environmental, health, and safety performance and the distribution and use of our products. As our customer, you need to share in the responsibility for safe handling, storage, and use of our products.

Follow these seven general safety recommendations:

1. Know and understand the properties, uses, and safety precautions before using any gas or gas mixture. Consult the Air Products Material Safety Data Sheet (MSDS) and Safetygrams for safety information on the gases and equipment you will be using.

2. Determine the appropriate equipment required to use the product and know how to safely operate the equipment.

3. Be aware of potential hazards and develop plans to cover possible emergencies. Use emergency drills to practice implementing these plans. Inform local hospitals, fire departments, and other emergency response organizations of the gases in use so that they, too, will be prepared in the event of an emergency.

4. Provide personal protective equipment (PPE) and the required training for its use. Require personnel to wear the proper PPE for each task. Locate other safety equipment such as fire extinguishers, eye wash stations, and showers at appropriate locations. Thoroughly inform everyone about the hazards of the gases they are using and how to respond to an emergency.

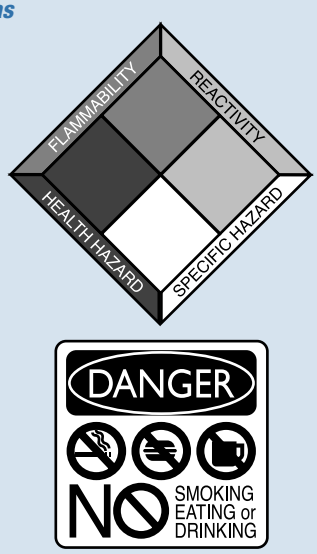
5. Follow all national, state, and local regulations pertaining to the storage, use, and disposal of compressed gases and cryogenic liquids. This document highlights the recommendations set forth in ISO Standard 11625, "Gas Cylinders—Safe Handling." In the United States, this document is published by the Compressed Gas Association as Pamphlet P-1, "Safe Handling of Compressed Gases in Containers," and has been incorporated into the regulations, making the contents of the document legal requirements in the United States, not recommendations. Other regional organizations such as the Asian Industrial Gases Association (AIGA), the European Industrial Gases Association (EIGA), and the National Fire Protection Association (NFPA) also provide guidance for the storage and use of compressed gas cylinders.

6. If you are unfamiliar with the hazards associated with a particular gas, contact your supplier for additional information.

7. Use appropriate equipment when handling portable cylinder banks. They have a high center of gravity, and extreme care must be taken during their movement. Portable banks may fall over when being moved if they are stopped suddenly by an object or crack in the floor.

Figure 1

Examples of signage used in storage areas



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Handling

Compressed gas cylinders should be handled only by those familiar with the hazards and who are trained in the proper handling techniques. Cylinders containing compressed gases are heavy and awkward to move. Improper handling of compressed gas cylinders can result in sprains, strains, falls, bruises, or 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. Take the following precautions to prevent injuries caused by the improper handling of compressed gas cylinders.

NEVER

- Drag or slide cylinders, even for short distances.
- Drop cylinders or permit them to strike each other violently.
- Subject cylinders to mechanical shocks that may cause damage to their valves.
- Use cylinders as rollers for moving material or other equipment.
- Tamper with pressure-relief devices.
- Permit oil, grease, or other readily combustible substances to come in contact with cylinders, valves, or other equipment in oxidizer service.
- Remove any product labels or shipping hazard labels.
- Refill compressed gas cylinders. This is to be done only by qualified producers of compressed gases.
- Lift a cylinder by its cap using a sling or a magnet.
- Attempt to catch a falling cylinder.

ALWAYS

- Move cylinders using a suitable hand truck or cart.
- Leave the valve protection cap and valve seal outlet in place until the cylinder has been secured in place and is ready to be used.
- Secure cylinders when in storage, transit, or use.
- When returning cylinders to the supplier, properly close the cylinder valve, replace and secure any valve outlet seals, and properly install the cylinder cap.

Figure 2

Typical cylinder hand trucks

- Use a cylinder cage or cradle to lift a cylinder.
- Use the proper PPE for cylinder handling. Wear safety glasses with sideshields, leather gloves, safety shoes, and other appropriate equipment.
- Use extreme care and restrict the movement of portable banks to localize movement on clean, smooth, level stationary surfaces.
- Use two people for localized manual movement of a portable bank. Stay out of the bank's travel path. Also, be aware of escape routes should the bank get out of control or start falling. If a smooth, level surface is not available over which to move the portable bank, use a forklift, crane, or other appropriate moving equipment.

Storage

Take the following precautions to prevent injuries caused by asphyxiation, fire, explosion, high pressure, and improper handling of compressed gas cylinders.

NEVER

- Allow storage temperature to exceed 125°F (52°C).
- Permit smoking or open flames in oxidizer or flammable gas storage areas.
- Expose cylinders to corrosive materials such as ice melting compounds.

ALWAYS

- Store cylinders in accordance with ISO Standard 11625 or CGA Pamphlet P-1.
- Store cylinders upright with valve outlet seals and valve protection caps in place. See Air Products' Safetygram-14, "Don't Turn a Cylinder Into a Rocket."
- Secure cylinders when in storage, transit, or use.
- Store cylinders in areas designated for that purpose.
- Segregate full and empty cylinders.
- Store cylinders in a dry, cool, well-ventilated, secure area protected from the weather and away from combustible materials.
- Ensure that there is adequate separation from combustibles as specified by national regulations.
- Monitor the atmosphere in areas where gases may vent and collect.
- Use a first-in, first-out (FIFO) inventory system to prevent full containers from being stored for long periods of time.
- Store only the amount of compressed gas required for the specific application.
- Store cylinders away from heavily traveled areas and emergency exits.
- Provide adequate access for cylinder handling.
- Visually inspect stored cylinders on a routine basis, or at least weekly, for any indication of leakage or problems.
- Restrict access to cylinder storage areas.
- Protect cylinders from wet or damp ground.

Proper Use of Compressed Gases

Take the following precautions to prevent injuries caused by the improper use of compressed gases.

NEVER

- **Attempt to mix gases in a cylinder.**
- Insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings to remove a stuck cylinder cap. Doing so may damage or open the valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.
- **Allow any part of a cylinder to be exposed to temperatures exceeding 125°F (52ºC).**
- **Permit cylinders to become part of an electrical circuit.**
- Use oxygen as a substitute for compressed air.
- **Strike an arc on a cylinder.**
- **Return product into a cylinder.**
- **Introduce another product into a cylinder.**
- Use cylinder color as a primary means to identify the contents of a cylinder.
- **Heat a cylinder to increase its pressure or withdrawal rate unless using an approved method. See Air Products' Safetygram-30, "Handling of Liquefied Compressed Gases."**
- **Discharge the contents from any gas cylinder directly toward any person.**
- **Refill any nonrefillable cylinder after use of the original contents.**
- **Force cylinder valve connections that do not fit.**
- **Reduce the residual pressure of a cylinder below the operating pressure of the system or 7 psig (0.5 bar), whichever is higher.**
- **Change service of equipment from the particular gas or group of gases for which they were intended.**

ALWAYS

- Know and understand the gases and associated equipment you will be using. Refer to the supplier's MSDS to determine the proper PPE and any other special requirements for the gas being used.

Figure 3

The correct way to safely check a system

- **Secure cylinders when in storage, transit, or use.**
- Use a pressure-reducing regulator or separate control valve to safely discharge gas from a cylinder.
- **Use regulators approved for the specific gas.**
- **Leak-test lines and equipment with an inert gas before using.**
- Use regulators and pressure-relief devices when connecting cylinders to piping circuits with lower pressure service ratings.
- **Use check valves to prevent reverse flow into the cylinder.**
- **Loosen the valve outlet seal slowly when preparing to connect a cylinder.**
- **Open cylinder valves slowly and carefully after the cylinder has been connected to the process.**
- **Stand clear of the regulator and valve outlet while opening the valve.**
- Prevent sparks and flames from contacting cylinders.
- **Discontinue use and contact the supplier if a cylinder valve is difficult to operate. Wrenches should not be used on valves equipped with handwheels. If the valve is faulty, tag the cylinder, identifying the problem, and notify the supplier.**
- **Close the cylinder valve and release all pressure from the downstream equipment connected to the cylinder anytime an extended non-use period is anticipated.**
- Use oxygen-compatible threading compounds, such as Teflon® tape on systems for use in oxygen or oxidizer service.
- Remember, the cylinder label or decal is the only positive way to identify the contents of a cylinder.

More information on gas handling is provided in Air Products' Safetygram-12, "Regulator Selection, Installation, and Operation."

AIR PRODUCTS

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Product Safety Information

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- For Safetygrams
  www.airproducts.com/Responsibility/EHS/ProductSafety/ProductSafetyInformation/Safetygrams.htm
- For Product Safety Information
  www.airproducts.com/Responsibility/EHS/ProductSafety/ProductSafetyInformation/

Technical Information Center

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- Call: +1-610-481-8565 (other locations)
- Fax: +1-610-481-8690
- E-mail: gasinfo@apci.com
- Monday–Friday, 8:00 a.m.–5:00 p.m. EST

Information Sources

- Compressed Gas Association (CGA)
  www.cganet.com
- European Industrial Gases Association (EIGA)
  www.eiga.org
- Japanese Industrial Gases Association (JIGA)
  www.jiga.gr.jp/english
- American Chemistry Council
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