Working with Gas Cylinders: Do’s and Don’ts

1. Wear safety glasses while working with gas cylinders and regulators.

2. Never transport a cylinder without its cap.

3. Always use the cylinder cart to transport gas cylinders.

4. *Never ride in an elevator with a gas cylinder; send the secured tank on its own!*

5. Post warning tags on cylinders traveling alone in the elevator.

6. Always secure the cylinder before attaching a regulator or opening valves.

7. Never use adapters to make a regulator fit another cylinder.

8. Do not use Teflon tape on regulator fittings

9. **Always look away from the cylinder when opening the cylinder valve.**

10. Always close the cylinder valve before tightening, loosening or making adjustments to the regulator fitting.

11. High pressure and low pressure cylinders should be fully opened (except for flammable gases which are opened only ¼ to ½ turns.

12. Regulators must be visually inspected for cracks and damage.

13. Complete an operation inspection of the regulator:
   a. Close cylinder valve-low pressure gauge valve; check and release all pressure in regulator
   b. Open cylinder valve-low pressure valve should read ZERO...if not regulator is faulty.
1.0. Policy

The purpose of the program is to minimize the possibility of injury, illness, and death in the workplace due to improper handling of pressurized gas cylinders. This written program applies to all personnel who work around or with pressurized cylinders.

2.0 Purpose

These instructions are provided to assist the user in the safe, effective operations of regulators. There are numerous hazards associated with the use of specialty gases. Hazards vary with each gas, the equipment utilized and with the particular application. It is therefore, impossible to list all of the hazards and necessary precautions. Common sense and experience are the basis for safety in high pressure gas control.

Compressed gases are safety hazards by their very nature; the gases in the labs present might pressure, asphyxiation and flammability hazards. Handling cylinder of compressed gasses should be met with proper training. Improper handling may result in serious injury or death. Additionally, as in handling any chemical, review the MSDS for each type of gas that is used.

Before performing any operation with which you are not familiar, seek the advice of an individual who knows how it should be done. The user must be aware of the additional hazards and safe operating practices specific to his/her equipment and application.

All Cary Institute of Ecosystem Studies employees who will be handling compressed gas cylinders must complete the ‘Compressed Gases: Compressed Hazards’ training module located online.

2.1 A gas pressure regulator is a precision instrument designed to reduce high source pressure (cylinders or compression systems) to a safe value, one consistent with a system’s design. Each regulator will control a chosen delivery pressure within the bounds of the regulator’s delivery-pressure range.

2.2 This constant delivery pressure prevents the overpressurization of any apparatus downstream of the regulator and permits stable flow rates to be established according to requirements.
3.0 Characteristics of Common Gases

- **Oxygen** – is a colorless, odorless and tasteless. It is slightly soluble in water, and it is a poor conductor of electricity. Use with extreme caution. It supports combustion and will combine chemically with practically all of the known elements except rare gases.

- **Nitrogen** – is a colorless, odorless gas. For most practical purposes it is considered chemically inert. It does not react with other elements, does not burn, and will not support combustion or respiration. It will chemically combine with the more active metals, lithium and magnesium to form nitrides and with hydrogen and oxygen and other elements at high temperature. It is slightly soluble in water and is a poor conductor of heat and electricity.

- **Helium** – is chemically inert, it is colorless, odorless and tasteless gas.

- **Hydrogen** – Gaseous hydrogen is colorless, odorless and tasteless. It will diffuse rapidly through many plastic materials. It is extremely flammable; burning in air with a pale bluish flame is nearly invisible. Although it is non-toxic, it can cause asphyxiation in confined spaces.

4.0 Know the Gas you will be handling

It is of the utmost importance that those properties of compressed gas that represent hazards (such as flammability, toxicity, chemical activity, and corrosive effects) be well known to the gas user. Learn about the gas properties before you put the gas to use.

- The hazards of toxic flammable and corrosive gases can be minimized by working in well ventilated areas. Where possible, work should be done in a hood.

- Use cylinder sizes that will assure use all of the gas within a reasonable amount of time. Leaks should not be allowed to go unchecked,

- When using toxic gases, it is advisable that some device or indicator be used to give warning of the presence of toxic concentration.

5.0 When corrosive gases are being used, the cylinder valve stem should be worked frequently to prevent freezing. The cylinder valve should be close when the cylinder is not in use. Regulators and valves should be flushed with dry air or nitrogen after use in corrosive gas service. Such
Control devices should not be left on a cylinder, except when the cylinder is in frequent use. When corrosive gases are to be discharged into a liquid, a trap, check valve, or vacuum-break device should always be used to prevent dangerous suck back.

6.0 Selecting a Regulator
6.1 Select a regulator which is suited for the particular gas service
6.1.1 Recommended regulators are specified in the supplies' catalogs for each gas listed.
6.1.2 CGA valve outlets are also noted for each gas and gas mixture, and the CGA inlet for the regulator must correspond....
6.2 Never use regulators with gases other than those for which they were intended
6.3 A single-stage regulator reduces the pressure from the main supply line pressure to the desired operating pressure.
6.4 A two-stage regulator is actually two regulators combined into one to give uniform regulation over a wider supply range, automatically.
6.5 Two stage regulators contain two diaphragms, two springs and two seats arranged in such a way as to reduce the pressure in two steps. In the first stage, the variable supply pressure is reduced to a constant intermediate pressure. Once the pressure is set, the two-stage regulator automatically keeps it constant.

7.0 Putting the Regulator into Service
7.1 Identify the regulator. Check the label and the inlet and outlet gauges. Ascertain that the high pressure gauge is suitable for the pressure of the cylinder or source system.
7.2 Inspect the regulator for evidence of damage or contamination. If there is evidence of physical damage or foreign material inside the regulator, return it to the supplier.
7.3 Inspect the cylinder valve for evidence of damage.
7.4 Attach the regulator to the cylinder and tighten the inlet nut securely.
7.5 Close the regulator by turning the adjusting knob to the full counterclockwise position. The regulator must be closed before opening the cylinder valve.

8.0 Safely Checking the System
8.1 With the regulator adjusting knob turned fully counterclockwise, place both hands on the cylinder valve and open it slowly, allowing the pressure to rise gradually in the regulator. Stand with the cylinder valve between you and the regulator.
8.2 When the high pressure gauge indicates maximum pressure, open the cylinder valve fully.
8.3 Always close the cylinder valve when it is no longer necessary to have it open. Do not leave it open when the equipment is unattended or not operating.

9.0 Adjusting the Pressure
9.1 Turning the adjusting knob clockwise, establish the required use pressure by referring to the low pressure gauge.
9.2 Make sure that the cylinder valve is easily accessible.
9.3 Never exchange the discharge (low pressure) gauge for one of lower pressure. The gauge may rupture if the adjusting knob is unintentionally turned in too far.

10.0 Precautionary Measures
10.1 Check the diaphragm regulators for creep (leakage of gas from the high pressure to the low pressure side when the low pressure side is turned off).
10.2 Provide check valves. Back-pressure protection is needed to prevent damage to a regulator. Gas from a high pressure system may back up.

11.0 Removing the Regulator from Service
11.1 Close the cylinder valve.
11.2 Vent the gases in the regulator and/or system, or isolate the system and vent the gases in the regulator by turning the adjusting knob clockwise to make certain that no pressure is trapped inside the regulator. If the gas is flammable, an oxidant, corrosive, or toxic, take appropriate measures to render it innocuous by employing a suitable disposal system before venting the gas to the atmosphere.
11.3 After relieving all the gas pressure, turn adjusting knob counterclockwise as far as possible.
11.4 All low pressure equipment connected to sources of high pressure should preferably be disconnected entirely or, if not, independently vented to the atmosphere as soon as the operation is over or shut down for an extended period of time.
11.5 Disconnect the regulator
11.6 If the regulator is to remain out of service, protect the inlet and outlet fittings from dire, contamination or mechanical damage.
11.7 Replace the cylinder valve cap.

12.0 Proper Discharge of Cylinder Contents
12.1 For controlled removal of the liquid phase of a liquefied gas, a manual control valve is used. Special liquid-flow regulators are also available.
12.2 Rapid removal of the gas phase from a liquefied gas may cause the liquid to cool too rapidly, causing the pressure and flow to drop below the required level. In such cases, cylinders may be heated in a water bath with the temperature controlled to go no higher than 125°F.
13.0 What to Do with Leaking Cylinders
- Inert Gases - Leaking cylinders of inert gases, such as argon, helium, nitrogen, etc. do not represent a hazard unless they are situated in confined places with no ventilation.

- Acid Gases – Acid gases are corrosive and toxic. Therefore, put on appropriate protective equipment (face shield, eye protection, rubber gloves, breathing equipment) before transporting the leaking cylinder to a safe out-of-doors area or a hood with forced ventilation.

- Alkaline Gases – The alkaline gases are corrosive, flammable and toxic. Put on appropriate protective equipment (face shield, eye protection, rubber gloves, and breathing equipment) before transporting the cylinder to hood with forced ventilation or to a safe out-of-doors area.

14.0 First-Aid for Gases
14.1 Most of the gases used are asphyxiates. The gases are stored in fairly well ventilated areas (the labs or open bunker). However, if too much gas is inhaled, remove the victim to fresh air. If the victim is not breathing, and it is safe to do so give CPR and seek medical assistance immediately.

14.2 If a fire should result from the use of any gas, the Cary Institute of Ecosystem Studies fire safety procedure should be followed.

16.0 General Guidelines for Gases in the Laboratory
Technicians will certainly work at times with gases in the laboratory, and they should always handle cylinders of compressed gas with approved safety operating procedures.

Precautions
1. Close off main cylinders valve when not in use.
2. Close needle valve or auxiliary cut-off valve in the line as well as that located at the cylinder. Do not rely solely on the cylinder valve.
3. Turn over cylinders in reasonable time. Turnover for corrosive gases should be 3 months or less.
4. Always use gases in areas where adequate ventilation is provided.
5. Keep cylinders in outside storage, or have manifolds piping low-pressure gas into buildings.
6. Use the smallest cylinder practical for your purpose.
17.0 Use of the Lecture Bottle

- The lecture bottle is the safest, best package for gases in small quantities. For noncorrosive gases, it is equipped with a leak free pack less valve with hand wheel control which provides good metering characteristics. No wrenches are required for cylinder valve operation, and hookup is simple. Lecture bottles for noncorrosive gases have both internal and external threads for compatibility with both new old needle valves and other accessories. The external thread permits the orientation of the regular to any position.

Caution - Special care must be used in changing lecture-bottle equipment from one gas service to another since outlets are separated from flammable and nonflammable regardless of the gas.

18.0 Storage of Cylinders and Transporting

18.1 Cylinders must be stored in a well ventilated area.
18.2 Store all cylinders upright on a level fire resistant floor.
18.3 Cylinders must be protected from falling by either a wall fixture, chain, strap or bench top clam with a train or strap.
18.4 Full, partially full and empties must be separated from one another to avoid confusion. All cylinders must be labeled with such.
18.5 All full, partially full and empties cylinders must be labeled and/or tagged with the quantity of its contents.
18.6 Flammables must be separated from combustibles by a distance of 25 feet.
18.7 Store cylinders in well ventilated areas.
18.8 Cylinders that may have a potential of rusting on the bottom must be protected.
18.9 Large gas cylinders should be transported by wheeled carts NEVER ROLL.
18.10 Cylinder valve caps are to remain in place at all times other than when cylinders are connected for use.

19.0 Points of Interest

The best protection against mishap with gases is knowledge of proper handling.
1. NEVER oil or grease the gas cylinder valves or regulators. It can result in a fire or explosion.
2. Never use a flame around any gas cylinder.
3. All cylinders should be transported strapped to a hand truck with the protective cap in place.
4. Once in place the cylinders should be secured.
5. Avoid unnecessary bumping or jarring of the cylinders.
6. When disconnecting a regulator, always stand to the side, wear eye protection and be certain the cylinder valve is closed and open valve adjusting the counterclockwise.
7. When a cylinder is empty, affix an EMPTY label to insure proper storage. Make arrangements with the gas supplier to remove all empty cylinders. This is done by a Cary Institute of Ecosystem Studies authorized person only.
8. Always store cylinders not in use (empty or full) with their safety caps on.
9. When changing a cylinder in the gas bunker, leave the bunker door open to provide ventilation. *This is done by a Cary Institute of Ecosystem Studies authorized person only.*
10. Storage of gas cylinders should take place in the Gas Bunker located by the main loading dock.

### 20.0 General Procedures and Caution

20.1 Use proper discharge controls – use automatic pressure regulators to reduce cylinder pressure to safe value. Manually operated valves can be used for liquid discharge control or intermittent gas flow control. Do not use cylinder valve to dispense gas.

20.2 Do not force connection fittings make sure connections to cylinders match the valve outlet. Do not interchange various controls on different gases.

20.3 Keep cylinders away from heat – do not subject any part of a cylinder to temperatures above 125F. Do not heat cylinders, unless permitted by supplier following his/her instructions.

20.4 Prevent contamination, use the trap check valve or vacuum break to prevent suck-back or foreign material entering the cylinder. Notify supplier if it is known that foreign material has entered the cylinder.

20.5 Prevent fire or explosion, do not store or discharge flammable gases where flames or sparks could possibly ignite diffusing gases.

20.6 Never tamper with safety devices in cylinders or valves, practically all cylinders and outlets valves have safety devices or various types with are important to safe usage of the gas. Never tamper with these devices in any way.

20.7 Check for leaks with Leak Detection solution (never use flames).

20.8 Determine contents correctly, observe tank pressure for non liquefied gases and do not empty to less than 25 psi; with liquefied gases determine contents by weighing since cylinder pressure remains constant until almost empty. Do not completely empty cylinder to prevent suck-back contamination.

20.9 Cylinder valves must be protected accept only cylinders provided with cylinder valve protection caps. Leave caps in place until ready to use gas.
20.10 Store properly provide definitely assigned location preferably in a fire resistant, dry and well ventilated area away from sources of ignition or heat. Outdoor storage areas should have proper drainage and be protected from direct rays of the sun.

20.11 Stabilize cylinders – secure cylinders by chaining or other means to keep them from falling accidentally.

20.12 Transport correctly – transport cylinders secured to a hand truck or suitable device. Do not roll cylinders.

20.13 Don’t Drop cylinders or permit them to strike each other violently.

20.14 Return in condition received – close valve, replace cylinder valve protective cap and dust caps. Mark or label the cylinder ‘EMPTY’.

20.15 Prevent confusing ‘Empty’s with ‘FULL’ cylinders. Store empties apart from full cylinders, to await return to supplier. Connecting empty cylinders by mistake to pressurized systems could cause contamination or violent reaction in cylinder.