

Standard Operating Procedure

Task: Changing Gas Cylinders

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Background:

- Pressurized gas cylinders are a convenient way to safely store and transport large volumes of gas for laboratory use. When properly used, they can provide an atmosphere of known purity and pressure to laboratory setups.

Training Requirements:

- Lab safety training
- Changing gas cylinder training

Potential Hazards:

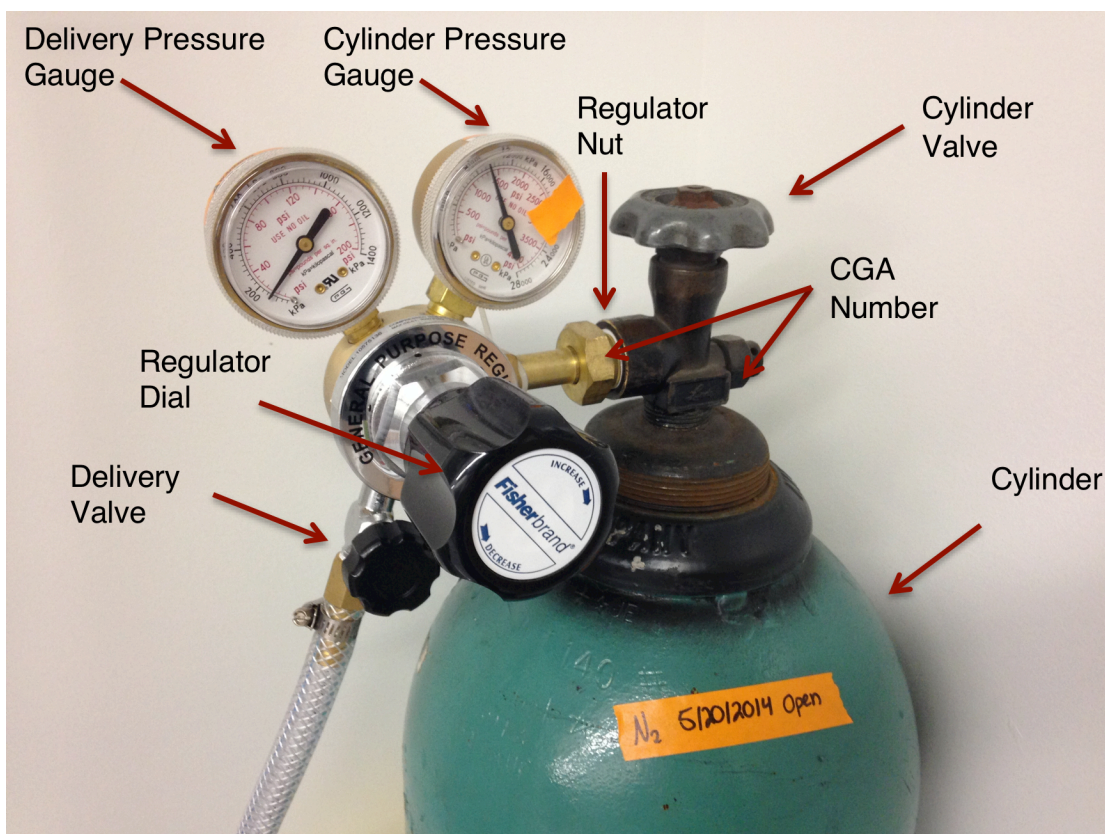
- Falling gas cylinders
- High Pressure gasses
- Potential Toxic/Flammable gases

Special PPE:

- Sensor or respirator for toxic gases (case dependent)

Materials Needed:

- Crescent wrench
- Gas cylinder cart
- Teflon tape (optional)

Procedure:

- Removing the regulator:
 - Assess the situation: know what gas you are changing, who might be using the gas, etc. Make sure no reactions are in progress that might be affected by the cylinder switch. **Wear appropriate specialty PPE for the gas being used.**
 - Close the main cylinder valve on top of the cylinder.
 - For toxic gases like CO, make sure to purge any residual gas into the hood: once the cylinder valve is closed, vent the residual gas through a bubbler or hose leading into a hood. The pressure gauges should read 0 psig for both cylinder and delivery pressure. Then close the delivery valve.
 - Using a crescent wrench loosen the regulator nut, connecting the regulator to the cylinder. If there is any residual pressure, you will hear a hiss as a small amount of gas in the regulator is released. After you have loosened the nut it should be unscrewed the rest of the way by hand. Make sure to support the weight of the regulator as you are unscrewing it.
 - As soon as the regulator has been removed the cap on top of the cylinder should be replaced.
- Moving cylinders
 - **Note: Cylinders should only be moved with the regulator removed and cap screwed on (unless a regulator protector safety cap is installed)**
 - Get the gas cylinder cart and move it next to the outgoing cylinder.

- Unstrap the empty cylinder and carefully roll it onto the gas cylinder cart. Secure the cylinder with the chain and carefully move it to be stored with other empty cylinders for pick up. Even empty cylinders should be double strapped. Label all empty cylinders using tape with the word “empty”.
- Find a new cylinder of the appropriate gas and move it into position using the cylinder cart. New cylinders should still have a plastic covering on the valve under the cap.
- Roll the new cylinder into position and secure it using two straps. Remove the cap and store it in a convenient place near where the cylinder is being used.
- Regulator information
 - Check the CGA numbers on *both* the cylinder *and* the regulator to make sure that they match. On most cylinders this number will be printed on a flat portion of the cylinder directly below the valve. On many regulators the CGA number will be printed on the regulator nut or underneath the dials.
 - **Note: Never use a regulator that is incompatible with the gas you are using.** The cylinders and regulators for flammable gasses are reverse threaded to ensure that they are only used together. The nuts on these regulators will also often be marked with a series of notches.
 - Some common CGA numbers are listed here. (A more complete list can be found at the end of this document)
 - CGA #580: Nitrogen, Argon, Helium
 - CGA #350: CO, Ethylene, Hydrogen, Methane, Regeneration gas
- Attaching the regulator
 - ~~Make sure that all old Teflon tape is removed from the regulator and the cylinder threads. Apply one complete wrap of new Teflon tape to the exposed threads (usually the nut on the regulator)~~
 - Align the regulator and cylinder threads and hand-tighten the nut while supporting the weight of the regulator.
 - Use a crescent wrench to fully tighten the nut (usually another 1/4-1/2 of a turn).
 - If the regulator has not been used recently — or you are unsure of the pressure setting — turn the regulator dial all the way to the left so that it will be set to its lowest pressure delivery setting.
- Leak testing
 - Once the regulator has been attached, it should be leak tested.
 - Make sure that the delivery valve is closed.
 - If working with a toxic or flammable gas, ensure gas cylinder is in a well ventilated area and a detector is on your person, if applicable.
 - Open the valve on the top of the cylinder. The cylinder pressure gauge should increase to about 2000 psi for most cylinders. The delivery pressure gauge should read 0 psig (the delivery gauge will not read pressure unless the regulator dial is open). Make a note of the pressure; a piece of tape is a good method. Then shut off the cylinder valve. If the pressure does not drop over the course of a few minutes there are no serious leaks between the cylinder and the regulator.
 - Next open the cylinder valve again as well as the delivery valve on the regulator. Again make a note of the pressure and then close the cylinder valve and watch to ensure that the pressure does not drop over a few minutes.

- If a slow leak is suspected, soap bubbles can be used to confirm the presence and location of the leak.
- A comment about Teflon tape
 - Different laboratories follow different guidelines for the use of “Teflon tape”, which is a thin, pliable film of poly(tetrafluoroethylene). In some groups, Teflon tape is used frequently when installing regulators, while in others this practice is not allowed. Some regulator manufacturers warn against the use of Teflon tape.
 - Those in favor of Teflon tape point to improved seals and more reliable operation when applied properly.
 - Those against the use of Teflon tape argue that properly maintained cylinders and regulators should make a tight metal-metal connection without leaks and warn that improper application of Teflon tape can stress the regulator components.
 - When using Teflon tape: Make sure that any old bits of tape are completely removed from the threads of the regulator and the cylinder. Use a plastic object to gently scrap off tape if needed (do not use razor blades, syringe needles, or other metal tools to avoid damaging the delicate threads). Apply one (and only one) complete wrap of new Teflon tape to the exposed threads (usually the nut on the regulator), working opposite to the direction of tightening. Use the thinnest tapes possible and do not wrap multiple times: thick layers of Teflon tape will put strain on the regulator as it is tightened.
- Standard regulator operation
 - After assuring that there are no leaks between the regulator and the cylinder, open the cylinder valve fully.
 - Adjust the delivery pressure, if necessary, by turning the regulator dial. Turning the regulator dial clockwise will increase the delivery pressure. Turning the regulator dial counterclockwise will decrease the delivery pressure.
 - Slowly open the delivery valve to admit gas into the system. Once flow is established, fully open the delivery valve. The delivery pressure may decrease after opening the delivery needle valve, so adjust the regulator dial to provide the desired pressure. The delivery pressure will drop more for higher flow applications.
 - In long-term applications of regulators, such as delivering argon to a Schlenk line, both the tank pressure and delivery pressure should be monitored occasionally. The tank pressure will steadily drop as the gas is depleted, and a replacement tank should be ordered well before the current tank would run out. The delivery pressure will change slightly over as a function of the tank pressure. There are two types of regulators, one-stage and two-stage. The major difference is that a two-stage regulator is relatively unaffected by drops in tank pressure, whereas a one-stage regulator will have a substantial loss in delivery pressure from a full cylinder versus an almost-empty cylinder.
- Storage after active use
 - When the cylinder is not actively in use (connected to a piece of equipment and properly supported), the regulator must be removed and the cap reattached.
 - Cylinders may be supported using mobile carts for gas delivery, but cylinders should not be left on the mobile carts after active use. Return the cart to a permanent storage rack.

- A maximum of two closed tanks can be doubly stacked from the permanent storage rack. **Active tanks should be should not be doubly stacked.**

CGA Reference Guide:

Pure Gases	CGA Number
Acetylene	510
Air (industrial)	590
Allene	510
Ammonia (anhydrous)	240, 260, or 705
Ammonia (electronic)	660 or 720
Air (medical)	346
Argon	580
Carbon dioxide	320 (<i>n.b.</i> fitting requires a special washer)
Carbon monoxide	350
Chlorine	660
Deuterium	350
Ethylene	350
Helium	580
Hydrogen	350
Methane	350
Nitrogen	580
Oxygen	540
Propane	510
Propylene	510

Lecture Bottles	CGA Number
Non-corrosive lecture bottles	170
Corrosive lecture bottles (use a purge valve)	180

Gas Mixtures	CGA Number
CO ₂ / Argon	580
H ₂ / N ₂ (regeneration gas)	350
H ₂ / CO (synthesis gas)	350
Natural gas	350

For gas or gas mixtures not listed above, refer to supplier to confirm CGA number.

References and Related SOPs:

- Degassing
- Regen
- Multireactor
- Working with CO
- [Concoa CGA Fitting Reference](#)