Introduction

Lecture bottles are small compressed gas cylinders, typically 12-18 inches long and 2-3 inches in diameter. They can hold a volume of between 37 and 125 liters, but some a small as 0.4 liters can be found. They contain small quantiles of gas that may be found in larger cylinders. Lecture bottle gases can be flammable, corrosive, inert or toxic. These gases are normally pure to ultrapure. Please see the Standard Operating Procedure "Compressed Gas Cylinders" for more information on hazards, cylinder labeling, regulators, storage and transport.

Hazards of Compressed Gas

Corroded acid gas lecture bottle

Corrosive
Gases that corrode material or tissue with which they come in contact, or do so in the presence of water, are classified as corrosive. Acid gas cylinders have a short shelf life, degrades the metal cylinders and valves, should not be stored for long periods of time and may be acutely toxic.

Flammable
A gas at normal atmospheric temperature and pressure that can be ignited and burned when mixed with the proper proportions of air, oxygen, or other oxidizers is considered flammable. Changes in temperature, pressure, or oxidant concentration may cause the flammability range to vary considerably.

Inert

Gases that do not react with other materials at standard temperature and pressure are classified as inert. They are colorless, odorless, nonflammable, and nontoxic. The primary hazards of these gases are the high pressure and potential for asphyxiation. These gases are often stored at pressures exceeding 2,000 psi. They can displace the amount of oxygen necessary to support life when released in a confined place. Use of adequate ventilation and monitoring the oxygen content in confined places will minimize the danger of asphyxiation.

Oxidizer
Gases that do not burn but will support combustion are classified as oxidants.

Toxic
Gases that may produce lethal or other harmful effects on humans are classified as toxic. The degree of toxicity and the effects will vary depending on the gas. The Safety Data Sheet should be consulted to determine the toxicity.

Lecture Bottle Use

- Inspect the lecture bottle and regulator prior to use; never use bottles or regulators that are damaged or corroded.
- Only use regulators and tubing that are appropriate for the gas. For example, stainless steel regulators and tubing must be required for corrosive gases.
- Lecture bottles must be properly secured and upright during use.

- Lecture bottles containing toxic gases must be used in a fume hood or gas cabinet.

Regulators
For a discussion on regulators see Standard Operating Procedure "Compressed Gas Cylinders" for more information.

Typical lecture bottle regulators

General gas use

General purpose regulators commonly have elastomeric diaphragms and are most often used in conjunction with packed valves. These regulators are typically forged brass but may be stainless steel depending on the corrosivity of the gas. They are the regulator of choice when slight contamination or diffusion from an elastomeric diaphragm is not important. Brass regulators with stainless steel diaphragms prevent air diffusion and adsorption of gases on the diaphragm. This is particularly important with low concentration mixtures of hydrocarbons, where the trace component may be adsorbed on the elastomeric diaphragm. Regulators with Buna-N neoprene diaphragms are not suitable for GC analysis that can be affected by the diffusion of atmospheric oxygen through the elastomer diaphragm or the outgassing of monomers and dimers from the elastomer.

High-purity gas

Specialty gases that are classified as high-purity or ultra-high-purity can be effectively delivered by regulators. High-purity regulators are typically made of brass and have stainless steel diaphragms. Ultra-high-purity regulators are typically constructed of brass or stainless steel bar stock, with convoluted stainless steel diaphragms having a metal-to-metal sealing without using backup O-Rings. Ultra-high-purity regulators used with highly corrosive gases typically have stainless steel diaphragms mechanically linked to the poppet assembly to provide additional sealing integrity.

A high-purity regulator equipped with a stainless steel diaphragm does not outgas organic materials. It also prevents the diffusion of atmospheric oxygen into the carrier gas, whereas Buna-N and neoprene diaphragms are permeable to oxygen.

Operating delivery pressure range

Determining the proper delivery pressure can be confusing. It is important to determine two application requirements: the gas pressure that is needed and the maximum pressure that the system may require (these two pressures may be the same). Then, select the regulator's delivery pressure ranges so the desired pressures are between 5 and 90% of the regulator's delivery range. A regulator's performance is at its best within this range.

Regulator placement (cylinder or line)

Specialty gas regulator applications are divided into two types. The first application features a regulator that is fastened to a gas cylinder using a Compressed Gas Association (CGA) fitting. The second application features a regulator that is located in a gas line, providing a means to further reduce the line pressure. A line regulator is identified by having the inlet and outlet opposite each other, with a single gauge in the 12 o'clock position to indicate the reduced pressure.

Lecture Bottle Storage

- All corrosive lecture bottles must be stored upright (vertically). Ensure lecture bottles are secured in a way to prevent bottles from falling (such as a lecture bottle holder). There are racks designed for this purpose (resembling and oversize test-tube rack) or they be firmly clamped to a ring stand with a heavy base, in an upright position.

Lecture bottle stands for use and storage

Improper Storage

- Lecture bottles stored on their side are more susceptible to damage, corrosion and leaks.
- Non-liquefied/non-corrosive lecture bottles may be stored horizontally in specifically designated racks.
- Do not stack cylinders.
- Do not store cylinders or lecture bottles with the regulator in place. If the regulator fails, the entire contents of the cylinder may be discharged.
- Segregate incompatible gases, such as flammable and oxidizing gases.
- Store poisonous gases in a fume hood or a ventilated gas cabinet.
- Lecture bottles must be properly labeled. Re-label the lecture bottle if the label becomes illegible or falls off.

Anhydrous Hydrogen Fluoride

Anhydrous hydrogen fluoride reacts over time with the iron in the steel to form iron fluoride and hydrogen. The hydrogen pressure can build up to the point where it ruptures the cylinder.
Anhydrous hydrogen fluoride lecture bottles must be disposed of within 2 years of purchase.

Lecture Bottle Purchase & Disposal

Unlike other gas cylinders, lecture bottles are not typically refillable. Most gas manufacturers do not take back lecture bottles. EH&S will pick up lecture bottle cylinders for hazardous waste disposal. Contact EH&S for a pickup.

Label lecture bottles that are not completely empty with a hazardous waste tag and approximate percent (%) of material remaining in the cylinder prior to submitting a hazardous waste request.
All partially full cylinders must have a proper valve cap prior to pick-up by EH&S.
If the cylinder is completely empty (no material will escape if the valve is opened), write “empty” on the label and/or on the cylinder.

Related Documents:
Compress Gas Cylinders SOP