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# **Handling Compressed Gas Cylinders in the Laboratory**

**Leader's Guide, Fact Sheet  
& Quiz**

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***This easy-to-use Leader's Guide is provided to assist in conducting a successful presentation.***

## **PREPARING FOR THE MEETING**

Here are a few suggestions for using this program:

- a) Review the contents of the Fact Sheet that immediately follows this page to familiarize yourself with the program topic and the training points discussed in the program. The Fact Sheet also includes a list of Program Objectives that details the information that participants should learn from watching the program.
- b) If required by your organization, make an attendance record to be signed by each participant to document the training to be conducted.
- c) Prepare the area and equipment to be used for the training. Make sure the watching environment is comfortable and free from outside distractions. Also, ensure that participants can see and hear the TV screen or computer monitor without obstructions.
- d) Make copies of the Review Quiz included at the end of this Leader's Guide to be completed by participants at the conclusion of the presentation. Be aware that the page containing the answers to the quiz comes before the quiz itself, which is on the final page.

## **CONDUCTING THE PRESENTATION**

- a) Begin the meeting by welcoming the participants. Introduce yourself and give each person an opportunity to become acquainted if there are new people joining the training session.
- b) Introduce the program by its title and explain to participants what they are expected to learn as stated in the Program Objectives of the Fact Sheet.
- c) Play the program without interruption. Upon completion, lead discussions about your organization's specific policies regarding the subject matter. Make sure to note any unique hazards associated with the program's topic that participants may encounter while performing their job duties at your facility.
- d) Hand out copies of the review quiz to all of the participants and make sure each one completes it before concluding the training session.

# 3060 HANDLING COMPRESSED GAS CYLINDERS IN THE LABORATORY

## FACT SHEET

**LENGTH: 14 MINUTES**

**PRODUCTION YEAR: 2014**

### **PROGRAM SYNOPSIS:**

Nowadays it's hard to find a laboratory that doesn't contain some type of compressed gas. While some laboratories now pipe gases in from a central storage location, many labs continue to use compressed gas cylinders to store and distribute the gases that they need. These cylinders are under a great deal of pressure and that makes them very dangerous. This program demonstrates the precautions needed to work safely in a lab.

### **PROGRAM OBJECTIVES:**

After watching the program, the participant will be able to explain the following:

- How gases are compressed and their dangers;
- Where gas cylinders should be stored;
- The proper way to handle a cylinder and its installation;
- How regulators and relief devices work;
- How to deal with leak emergencies.

### **INSTRUCTIONAL CONTENT:**

#### **INTRODUCTION**

- Nowadays it's hard to find a laboratory that doesn't contain some type of compressed gas. Laboratories use these gases in many ways: to fuel heating devices, like Bunsen burners, to keep materials and equipment cool; as a part of experiments and processes themselves.
- While some laboratories now pipe gases in from a central storage location, many labs continue to use compressed gas cylinders to store and distribute the gases that they need. And there's a lot of gas squeezed into one of these cylinders. For example, a cylinder full of compressed hydrogen contains enough gas to fill a 260 cubic foot room. Of course, that's why gas cylinders exist: to reduce the space that's needed to store gases.
- Obviously, the gas in a compressed cylinder is under a great deal of pressure. And that makes the cylinders very dangerous.

#### **COMPRESSION AND ITS EFFECTS**

- There are four basic ways to store pressurized gases.
- The first is called standard compression. This is where substances such as hydrogen or helium are squeezed into a cylinder but kept in their gas form.
- The second way to store a gas is as a liquid. This works for gases that condense under ordinary temperatures or at pressures between 25 and 2,500 pounds-per-square-inch, such as carbon dioxide and propane.
- The third storage method is to dissolve a gas in a solvent. Acetylene is the only common gas that's stored this way, because it's unstable in its pure form and must be dissolved to be stored.
- The fourth method is to compress a gas into a very cold, cryogenic liquid. This is only used for substances with boiling points below negative 238-degrees Fahrenheit, like nitrogen, oxygen and argon.
- It's important to know how each of the gases we work with is compressed, and as a result, how it behaves. We also need to know what precautions to take to handle each gas safely.
- One of the first things to think about is personal protective equipment. For instance, to work with cryogenics, you should use goggles, a face shield and insulated, impervious gloves. Without PPE your skin could be severely burned. Prolonged exposure could even cause frostbite.
- And since compressed gas cylinders are heavy even when they're empty, it's a good idea to wear safety shoes too.
- Cryogenics have other unique problems. Extremely low temperatures can make valve washers brittle, and they can break away and cause leaks. Cold steel can fail when subjected to impact.
- Another problem with cryogenic liquids is that they produce huge volumes of gas when they vaporize. For instance, if the gas is oxygen, it can quickly enrich the atmosphere, increasing the chances for a fire or explosion. A leak of some

other cryogenic gas may push breathable air out of the room, which could cause asphyxiation.

- We've all heard about another hazard that's associated with compressed gas cylinders. If a cylinder falls and damages its valve, the rapid release of gases could turn the cylinder into a rocket, so you can see why it's so important to handle compressed gas cylinders very carefully.

## **CYLINDER STORAGE**

- How compressed gas cylinders are stored is also important. Cool, dry, well-ventilated spaces are best.
- Cylinders should be secured upright, strapped or chained into place to prevent falling or bumping. Safety caps should remain on until the cylinders are hooked up to their systems.
- Compressed gas should also be kept out of direct sunlight. Rising temperatures can increase the internal pressure in the cylinder.
- Flammable gases should be separated from oxidizers by at least twenty feet or by a wall. Any mixture of these gases could be dangerous. Flammables and oxidizers also need to be kept away from live electrical equipment and other potential sparking sources.
- And smoking is never permitted in cylinder storage areas.
- Being able to easily see what gas a cylinder contains is important too. Never tamper with a cylinder's identifying labels or stencils. These are the only ways to really tell what gases are inside. You can't rely on a cylinder's paint color, since different manufacturers use different color schemes.
- You need to know what the "shelf life" of your gas cylinders is as well. Cylinders containing corrosive gases shouldn't be stored for more than six months. The same goes for substances that might undergo hazardous polymerization. Containers of ethylene oxide should never be stored for more than three months, unless they're refrigerated.

## **HANDLING AND INSTALLATION**

- How to handle a compressed gas cylinder when you're moving it and hooking it up is something else you need to know.
- Never drag a cylinder across the floor. This can damage the walls of the cylinder or its valve. Hand rolling is also a bad idea. The cylinder can easily slip and fall, creating all sorts of problems.
- Moving cylinders with a hand truck is always the safest course. Four-wheeled versions are the most stable.
- You should use service elevators or dumbwaiters to move cylinders between floors.
- But riding along with a cylinder is not a good idea. An elevator is a small space, and a leaking cylinder can quickly foul the air with nowhere for you to go. Instead, walk up the stairs to meet the cylinder when it arrives, or have someone else in position to accept it.
- Safety caps should always be in place whenever a cylinder is being transported, even over a small distance. A cap protects the cylinder's valve in the event it falls or bumps into something.
- If a falling incident does occur, don't try to catch the cylinder. This may seem like strange advice when you consider the damage a broken cylinder can do. But more people are injured while trying to catch heavy, falling cylinders than when the cylinders shoot around out of control.
- You're best off when you leave safety caps on, handle cylinders with care and always wear safety shoes.
- Once a cylinder gets to its final destination, there are other things to consider. Every lab should be equipped with fastening systems that will keep cylinders upright. A rack system is often the best approach. They use clamps to keep the cylinders in place.
- The strongest clamps are anchored to the wall or a lab bench at two points. The cylinders should fit into the racks tightly. Clamps with thumbscrews are the easiest to snug up. The aim is to keep cylinders from falling or knocking into one another. Any physical stress can lead to leaks or ruptures.
- Chains generally aren't as good a solution, since they tend to be looser than straps, and don't always keep a cylinder well secured. If you must use a chain, make sure it's as tight as possible.
- Some states have more rigorous requirements than others for securing cylinders and lab accreditation groups may also have their own guidelines. Ask your supervisor what laws and regulations apply to your lab.
- Once you have a cylinder in place, it's finally safe to unscrew the cap. Never force a cap off with a screwdriver or bar. You could accidentally open or damage the valve.
- One last caution. If at any time you detect a gas leak while you're handling a cylinder, report it to your supervisor and the equipment supplier immediately. Then remove the cylinder from service. This goes for rusty or corroded cylinders as well.

## **REGULATORS AND RELIEF DEVICES**

- To hook a cylinder into a gas delivery system you need to know how several things work. The first is the cylinder's regulator. This device is crucial to controlling the flow of gas out of the cylinder. As we've discussed, cylinders are filled to extreme pressures. The task of the regulator is to reduce the delivery pressure to a safe, usable level.
- The second device is the CGA fitting. This should be permanently attached to the regulator. It connects to the cylinder valve to allow the gas to flow out.
- CGA's vary, depending on the type of gas. Some CGA's are larger than others, some have washers, some have notches. Threads may be right or left-handed, so hooking up the wrong cylinder to a system becomes very hard to do... which is the whole idea. This is all done because mistakes with compressed gases can be critical. For instance, a flammable gas mistakenly hooked into a system near an ignition source could cause an explosion.
- So never attempt to force a CGA onto a valve. If it isn't fitting correctly, there's a reason.
- The third piece of equipment you have to deal with during a hook-up is the cylinder's pressure relief device. These are installed to prevent a rupture and violent release of pressure if the cylinder is exposed to extreme heat. For instance, if there's a fire in the lab and the cylinder heats up, the relief device will open and allow for a controlled release of the gas inside.
- While if the gas is flammable this will add fuel to the fire, it's still preferable to the cylinder exploding. However, there are no relief devices on cylinders used to store toxic or poisonous substances. Any escape of these gases is considered too dangerous to risk.
- A last device, a flame arrestor, is often used with flammable gas cylinders. This helps to prevent "flashback" into the cylinder in case a fire develops somewhere in the system.

## **DEALING WITH LEAK EMERGENCIES**

- Once you've assembled your gas system and have it up and running, you should check all fittings and valves for leaks. An easy way to do this is to cover the surfaces with a diluted soap solution. If you see any bubbles, you've got a problem.
- Let's look at what would happen if a cylinder full of compressed hydrogen develops a leak at the valve. The pressure in the cylinder forces out the gas, pushing it great distances. It can flow over bench tops, past electrical devices and heat sources, and in its travels find a source of ignition...a spark or open flame.
- There are three things going on here: a leak in the system, the wide dispersal of the gas caused by the pressure in the cylinder and finally, the specific hazards of the substance itself, in this case its flammability.
- While most leak repairs are simple, you still need to take precautions.
- First and foremost, you should follow your facility's Emergency Plan and the directions on the Safety Data Sheets for the gases that you're working with. But there are also some things that you should do for any leaks.
- Immediately alert other employees in the area.
- Depending on the size of the leak and the gas that's involved, you may have to evacuate the lab. Make sure you know both the primary and secondary evacuation routes.
- Once you've made sure that everyone is safe, notify your supervisor so that the needed repairs can be made.

## **CONCLUSION**

- Using gas cylinders is only complicated when you don't do your homework. Let's review.
- Always be aware of the properties, and hazards, of the gases you work with. Know how to safely store and transport compressed gas cylinders. Remember the rules for using regulators, CGA's and pressure relief devices, as well as how they work. Know the procedures you should follow to hook cylinders into gas systems correctly. And be prepared to deal with a gas leak or other gas-related emergency.
- Most accidents involving compressed gases should never happen. With some preparation and foresight, you can keep the gases that you use under control... and your lab safe and incident free.

## **HANDLING COMPRESSED GAS CYLINDERS IN THE LABORATORY**

### **ANSWERS TO THE REVIEW QUIZ**

1. a

2. d

3. b

4. a

5. b

6. a

7. b

## HANDLING COMPRESSED GAS CYLINDERS IN THE LABORATORY

### REVIEW QUIZ

*The following questions are provided to determine how well you understand the information presented in this program.*

Name \_\_\_\_\_ Date \_\_\_\_\_

1. The proper way to move a compressed gas cylinder is by using a hand truck, preferably a four-wheeled one.
  - a. True
  - b. False
2. Which of the following are ways to store pressurized gases?
  - a. Standard compression
  - b. Liquid
  - c. Dissolved in a solvent
  - d. All of the above
3. Pressure Relief Devices control the speed at which a gas comes out of cylinder.
  - a. True
  - b. False
4. The purpose of a regulator is to decrease the delivery pressure of compressed gases to a usable and safe level.
  - a. True
  - b. False
5. A good way to tell what type of gas is in a cylinder is by the color the cylinder is painted.
  - a. True
  - b. False
6. Cylinders that contain corrosive gases should not be stored for more than 6 months.
  - a. True
  - b. False
7. Cylinders containing flammable gases and cylinders containing oxidizers can be safely stored together.
  - a. True
  - b. False