

PRESENTER'S GUIDE

"COMPRESSED GAS CYLINDERS"

Part of the General Safety Series

OUTLINE OF MAJOR PROGRAM POINTS

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The following outline summarizes the major points of information presented in the program. The outline can be used to review the program before conducting a classroom session, as well as in preparing to lead a class discussion about the program.

- **These days it's hard to find a facility that doesn't use compressed gases in some way.**
 - They are used as part of welding systems, in manufacturing, maintenance, refrigeration, medical procedures and even lab experiments.
- **The cylinders that contain these gases make their distribution, storage and utilization practical and economical.**
- **A lot can be squeezed inside a compressed gas cylinder, but it takes a lot of force to do it. For example:**
 - The compressed oxygen in a typical cylinder puts about twenty-two hundred pounds, or a little more than one ton, of pressure on every square inch of its container's walls.
 - That kind of pressure can be dangerous.
- **The gases contained in the cylinders can present hazards of their own.**
- **To take the right precautions with a compressed gas cylinder, you need to know what's inside it.**
 - Guessing about it is a recipe for disaster.
 - Hooking a cylinder full of the wrong gas into a system could be the last mistake you ever make.
- **The color of a compressed gas cylinder won't tell you anything about its contents.**
 - Cylinder colors are not standardized.
 - They're chosen by the companies that own the cylinders.
 - Each owner may have a different "color-coding" system.

- **It's the labels on the cylinders that really tell you what's inside. They will provide you with:**
 - The name of the gas.
 - The hazards you should watch out for.
 - How to handle the gas safely.
- **Never remove, deface or change a cylinder's identifying labels.**
 - That could create big problems for the next person who uses it.
- **The characteristics of different gases require different methods of storing them in a cylinder.**
 - Most gases are stored in one of four ways.
- **The first method is called "standard compression".**
 - This is when substances such as hydrogen and helium are "squeezed" into the cylinder in the form of a gas.
- **The second way to store a gas is as a liquid.**
 - This works well for gases such as carbon dioxide and propane that liquefy under ordinary temperatures and at pressures between 25 and 2,500 pounds-per-square-inch.
- **The third storage method is to dissolve the gas in a solvent before putting it into a cylinder.**
 - 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 safely.
- **In the fourth method, gases are condensed by "super-cooling" so they can be stored as "cryogenic liquids" in special, insulated cylinders.**
 - This is used for substances such as nitrogen, methane and sometimes oxygen... that have boiling points hundreds of degrees below zero, and would evaporate under normal temperatures.

- **It's important to remember that these cryogenic cylinders' low temperatures can require special safety measures when they are handled.**
 - Personal protective equipment such as goggles, a face shield and insulated gloves need to be worn to avoid burns and even frostbite.
 - Cryogenic containers should be handled gently, because their super-cooled steel is more likely to shatter than a normal cylinder's.
 - Leaks are more likely with cryogenic cylinders, too, because valve washers on the containers can become brittle, break and allow gas to escape.
- **Don't forget that non-cryogenic compressed gas cylinders require careful handling as well!**
- **Compressed gas cylinders have two general types of hazards:**
 - Those created by the high pressures that are exerted on the cylinders themselves.
 - Those that are associated with the specific gases they contain.
- **Because the gas inside is highly pressurized, damaging a cylinder valve can be very dangerous.**
 - If the valve opens unexpectedly, or breaks off completely, the rapid release of gas can make the container take off like a rocket.
 - Ricocheting around at a very high speed, it can do extensive damage to property and injure people.
- **If for any reason the metal "body" of a cylinder fails, it can also explode with deadly force and scatter fragments just like a bursting artillery shell.**
- **This brings us to the particular hazards of the gas inside the cylinder.**

- **Imagine a cylinder that's set up in a lab, on a plant floor, or in the basement of an apartment building.**
 - A faulty connection begins to leak.
 - The pressure continuously pushes the gas into the atmosphere, where it disperses throughout the space.
- **If the gas in the cylinder is flammable, like hydrogen or methane, all it has to do is find a source of ignition, such as a spark or flame, and it will burn or even possibly explode.**
- **If the gas is in an oxidizer, such as oxygen or chlorine, while it won't burn itself it can "help" a fire start more easily and burn more fiercely once it's underway.**
- **If the leaking gas is a corrosive like ammonia, or toxic like carbon monoxide, it can cause physical injury or poison anyone who is exposed to it.**
- **All of these gases can be very hazardous, even in low concentrations, and are often invisible and/or odorless as well.**
 - Any gas other than oxygen or plain air that leaks from a cylinder can push breathable air out of a space, so that the people inside will suffocate.
- **Remember too, that any gas is more hazardous when it's stored as a cryogenic liquid, because cryogenics give off such large quantities of gas when they vaporize.**
 - Bigger volumes of gas can cause bigger problems.

- **Compressed gas cylinders may spend considerable time in storage before they're used, so it's important to know how to store them safely.**
 - Cylinders should be stored in a cool, dry, well-ventilated space.
 - Smoking should never be allowed in a cylinder storage area.
 - They should be stored in an upright position and secured with straps or chains to prevent them from falling or bumping against each other (draping a chain loosely around a cylinder is not an adequate safeguard!).

- **Cylinders should also be kept out of direct sunlight, which could overheat them and cause the gas inside to try to expand, with nowhere to safely go.**
 - Cylinders should also always be stored with their safety caps in place.

- **More detailed information on safe storage practices for specific types of gases can be found on their cylinder's label, or on the material's SDS.**

- **Special precautions are required to safely store cylinders that contain flammable gases and oxidizers**
 - To reduce the risk of fire they must be kept away from live electrical equipment, open flames or any other potential sources of ignition.
 - Flammable gases should also be separated from oxidizers, either by a wall or a distance of at least 20 feet.

- **Compressed gas cylinders make it simpler to work with gases, but the cylinders themselves need to be handled with care.**

- **First, whenever you move a cylinder, even over a short distance, make sure its "safety cap" is on.**
 - This cap protects the cylinder's valve in the event of a bump or fall.
 - It should always be in place when a cylinder is being transported... and whenever it's not being used as well.

- **Never drag a cylinder across the floor.**
 - This can damage the walls of the cylinder, especially at the base.
 - If the base becomes uneven, the cylinder will be unstable when it's set upright.
- **An unstable cylinder is more likely to fall, and cause damage to its valve or other cylinders nearby.**
 - It can also cause leaks in any gas lines it's connected to.
- **Don't "hand roll" cylinders for anything more than a few feet, either.**
 - They're hard to control when you do this, and dropping a cylinder is very dangerous.
- **But if a compressed gas cylinder starts to fall, don't try to catch it!**
 - More people are injured by trying to catch heavy, falling cylinders than by any other compressed gas hazard.
 - Always wear safety shoes with steel toes when you're handling cylinders.
 - That way if one does fall, your toes will at least stay intact!
- **The safest way to move compressed gas cylinders is with a "cylinder hand truck".**
 - These have curved braces that cradle a cylinder, and chains or straps to secure it in place.
- **When moving cylinders between floors, use service elevators or dumbwaiters.**
 - But riding along with a cylinder in an elevator is not a good idea.
 - Until the door opens at your destination, you're stuck in a very small space, and a leaking cylinder can quickly foul the air inside.
 - So walk up the stairs to meet the cylinder when it arrives, or have someone else positioned there to receive it.

- **Once you get a cylinder to its destination, you need to secure it safely in place.**
 - Just as when they're in storage, the goal here is to prevent cylinders from falling over or knocking against one another.
 - Physical stresses like that can lead to gas leaks, and much worse.
- **Each location where cylinders are used should be equipped with some type of fastening system, such as brackets, racks or stands, to keep them upright and stable.**
- **For maximum stability, cylinders should be secured at at least two points.**
 - Straps or chains are usually used for this.
 - Straps are preferable, since chains tend to be looser, and don't always do a good job of keeping a cylinder in place.
 - If you must use a chain, make sure it's as tight as possible.
- **Requirements for securing compressed gas cylinders can vary from state to state.**
 - Ask your supervisor about the specific laws and regulations that apply to you.
- **Once a gas cylinder has been put in place, it's safe to unscrew the cap.**
 - You should never force a cap off with a screwdriver or pry-bar.
 - That could accidentally open the valve, or damage it.
- **There are two valve components that are critical for a safe hookup.**
 - The first is a regulator, which controls how fast the gas can flow out of a cylinder.
 - This device reduces the "delivery pressure" to a level that's safe and practical for the user at the other end.

- **The second component is a CGA fitting ("CGA" for short), which connects the regulator to the cylinder.**
 - In most cases the CGA is attached to the regulator permanently.
- **The purpose of a CGA is to make sure that the gas in a cylinder is the right one for the system it is being hooked up to, so design details of CGAs will vary, depending on the type of gas in the cylinder.**
 - Some CGAs are larger than others.
 - Some have washers, some have notches.
 - They can have right- or left-hand threads.
 - Each design "matches" a specific gas to its appropriate delivery system.
- **When a CGA doesn't fit easily onto a cylinder's valve, there's a probably a reason for it.**
 - That's why you should never attempt to connect them by force.
 - That "stubborn" CGA is actually preventing something bad from happening.
- **And you should never try to attach a regulator directly to a cylinder's valve without a CGA.**
- **There's another safety fitting on most valves you should know about, and it's actually designed to purposely leak under certain circumstances.**
 - It's called a "pressure relief device", or PRD.
- **If the pressure in a cylinder gets dangerously high, the PRD opens and vents off some of the gas, reducing the pressure and preventing a potential "explosion".**
 - For instance, if a fire breaks out in a facility the cylinders there can heat up.
 - When the pressure inside them builds, the PRDs will open and allow the gases to bleed off safely.
 - This means that firefighters can enter the facility to battle the blaze without fear of encountering exploding cylinders.
 - If the gas inside the cylinders is flammable, the release will "only add fuel to the fire", but that's still preferable to having the cylinder explode.

- **On the other hand, you won't find PRDs on cylinders that contain toxic or poisonous substances.**
 - Any escape of these gases is considered too dangerous to risk, even more dangerous than the possibility of the cylinder exploding.
- **Many of the safe practices that are used with compressed gas cylinders focus on preventing "leaks".**
 - This is why you should always remove rusty, corroded and damaged cylinders from service immediately, before they develop a leak.
- **If you ever detect a gas leak while you're handling a cylinder, alert your supervisor right away and remove the cylinder from service if you're authorized to do so.**
- **You should always test for leaks in the connections after you've installed a new cylinder into a gas delivery system.**
 - You can do this by wetting down the surfaces with a diluted soap solution.
 - If bubbles appear, you know that there's a leak somewhere.
- **To pinpoint the source of the leak, wipe off the general area, then reapply the soap solution to a smaller section of the connection.**
 - If bubbles don't appear, wipe the solution off and try another section.
 - Keep going until you find the leak.
 - Remember to wipe off the old solution before each new test.
- **Leaking valves can often be repaired just by tightening them.**
 - Make sure you have the correctly-sized wrench or other "tightening tool" handy.
- **If you can't fix a leak, alert other employees in the vicinity.**
 - They may need to evacuate the area.
 - Then notify your supervisor.

- **If you're qualified and have been asked to repair a leaking cylinder that hasn't responded to tightening, be extremely careful.**
 - First, obtain the SDS for the gas that's in the cylinder, and determine its characteristics and potential hazards.
 - If necessary, have back-up personnel in place to help you.
 - Wear a self-contained breathing apparatus (SCBA) to do the work.
 - If the problem persists, take further action according to your facility's Emergency Action Plan.

*** * * SUMMARY * * ***

- **There's no question that compressed gas cylinders make working with gases easier... but this advantage comes at a price, and we need to take care to use the cylinders safely.**
- **Be sure you're aware of the potential hazards of the gas cylinders that you work with.**
- **Know the properties and hazards of the gases inside, and the precautions that are required to work with them.**
- **Always use proper procedures when you're storing and transporting compressed gas cylinders.**
- **Understand the purpose of regulators and CGA's, and how to hook them up correctly.**
- **Know how to check cylinders and valves for leaks, and be prepared to deal with a leak if you find one.**
- **Accidents involving compressed gases don't "have" to happen.**
- **Treat the cylinders and the gases inside with the care and respect they deserve, and you'll help keep yourself, your coworkers and your facility safe and accident-free!**