

COMPRESSED GAS CYLINDERS IN HEALTHCARE ENVIRONMENTS

COURSE OUTLINE

- **To take the appropriate precautions when you're handling 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.
- **So let's dispel one myth right up front... 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.
 - And each owner may have a different "color-coding" system.
- **It's the label that's affixed to a compressed gas cylinder that really tells you what's inside.**
 - It will provide the name of the gas, the hazards you should watch out for, and 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.
- **Different types of 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 a 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 nitrous oxide that liquefy under ordinary temperatures and at pressures between 25 and 2,500 pounds-per-square-inch.

- **The third approach to storing a gas 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 that they can be stored as “cryogenic liquids” in special, insulated cylinders.**
 - This approach is used for substances such as nitrogen, methane and sometimes oxygen.
 - They have boiling points hundreds of degrees below zero, and would evaporate under normal temperatures.
- **It's important to remember that because of these cylinders' low temperatures you will need to take special safety measures when you handle them.**
- **To avoid burns and frostbite, you need to wear personal protective equipment such as...**
 - Goggles.
 - A face shield.
 - Insulated gloves.
- **Cryogenic containers should be handled gently.**
 - Their super-cooled steel is more likely to shatter than a normal cylinder's.
- **Leaks are more likely to occur with cryogenic cylinders, too, because the valve washers on the containers can become brittle, break and allow gas to escape.**
 - But don't forget, “ordinary” compressed gas cylinders require careful handling too.
- **Compressed gas cylinders have two general types of hazards.**
 - First, the hazards that exist because of the high pressures that are exerted on the cylinders themselves.
 - And second, the hazards that are associated with the specific gases that they contain.
- **Because the gas inside is highly pressurized, damaging a cylinder's 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.
 - This could cause it to ricochet around at a very high speed, and doing extensive damage to property and people.

- **If for any reason the metal “body” of a cylinder fails, it can also explode with deadly force.**
 - This leads to scattered metal fragments just like from a bursting artillery shell.
- **This brings us to the hazards that are typically associated with the gas inside a cylinder.**
- **Imagine a cylinder that’s set up in a patient room, a lab, or a maintenance shop.**
 - 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, all it has to do is find a source of ignition and it will burn or even possibly explode.**
 - If the gas is 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 corrosive like ammonia, or toxic like carbon monoxide, it can cause physical injury, or poison anyone who is exposed to it.**
 - To make matters worse, all of these gases can be hazardous even in low concentrations, and are often invisible and/or odorless as well.
- **It is also important to realize that any gas other than oxygen or plain air that leaks from a cylinder can push the breathable air out of a space.**
 - So anyone inside will suffocate.
- **Remember too, that any gas is more hazardous when it’s stored as a cryogenic liquid.**
 - This is because it gives off such large quantities of gas when it vaporizes.
 - And bigger volumes of gas can cause bigger problems.
- **Compressed gas cylinders can 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 placed 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 that are stored in a manifold room are actively being used and need to be changed out immediately when they're empty.**
 - Remember to always check for leaks near the pipeline connections or "pigtails" when you're moving cylinders to and from the room.
- **Cylinders should also be kept out of direct sunlight.**
 - It could overheat them and cause the gas inside to try to expand... with nowhere to safely go.
 - And cylinders should 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 gas'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 and oxidizers should also be separated from each other, either by a wall or a distance of at least 20 feet.
- **Compressed gas cylinders make it easier 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 firmly.**
 - It protects the cylinder's valve in the event of a bump or fall, and should always be in place when a cylinder is being transported or stored.
- **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, potentially damaging its valve or other cylinders nearby, causing 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.
- **If a compressed gas cylinder that you are working with does start to fall, don't try to catch it!**
 - They're heavy and can do some real damage.
 - In fact, more people are injured by trying to catch 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.**
 - They have curved braces that "cradle" a cylinder, and chains or straps to secure it in place.
- **When you're moving cylinders between floors, use service elevators or dumbwaiters.**
 - Riding along with a cylinder 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 this can lead to gas leaks... and much worse.
- **Each location where cylinders are used should be equipped with some type of fastening system to keep them upright and stable, such as...**
 - Brackets.
 - Racks.
 - Stands.
- **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 and handling compressed gas cylinders can vary from state to state.**
 - So ask your supervisor about the specific laws and regulations that apply to you.
- **Working with compressed gases isn't always just about moving and securing cylinders.**
 - Sometimes, you'll need to help a patient access the gas the cylinders contain.
- **There are two ways that this can occur.**
 - Directly from a cylinder.
 - Through a "manifold system".
- **If you're working with a manifold system, you connect the patient to their gas through the outlet in their room.**
 - Remember to check for wear and tear around the outlets, as they can leak if they aren't functioning properly.
- **You should also regularly inspect the hose that is used to connect the patient to the outlet for holes and kinks.**
- **Other times you may need to work with a gas cylinder directly.**
 - Portable tanks or cylinders are often used in emergencies, for transportation, or if for some reason the manifold system fails.
- **Before you connect a patient to a gas cylinder, make sure your hands and clothes are clean.**
 - If a gas comes into contact with oil or grease it could cause an explosion.
- **Always check the expiration date of any gas cylinder you are working with.**
 - Medical oxygen has a shelf life of three years.
 - While the oxygen itself won't "expire", using it past its expiration date risks the cylinder becoming damaged, rusted, or unsuitable for use.
- **It is also important to check a cylinder's pressure gauge.**
 - This will ensure there is enough gas in the cylinder to create the needed delivery pressure.
 - For oxygen, it should read about 2,000 psi.

- **You could also end up working with cylinders directly when “at-home” patients need oxygen or another medical gas.**
 - If you’re delivering a gas cylinder to a patient’s home, use a well-ventilated vehicle.
 - Keep it secured on the floor of your backseat.
- **The cylinder should never travel in an enclosed trunk.**
 - Being closed in prevents the gas from dispersing if there’s a leak.
- **Remember, when you’re working with compressed gases with patients, you are responsible for your and their safety.**
 - So, it’s important to be cautious at all times.
- **Once a gas cylinder is in place, it's safe to unscrew the cap.**
 - But 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” 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.
 - And they may 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 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.

- **There's also another safety fitting on most valves that you should know about, and it's actually intended to 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 healthcare facility the cylinders there can heat up.
 - When the pressure inside them builds, the PRDs will open and allow some gas to safely bleed off.
 - This means that firefighters can enter the facility to battle the blaze without fear of encountering exploding cylinders.
- **Of course, if the gases inside the cylinders are 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 types of gases is considered too dangerous to risk... even more dangerous than the possibility of the cylinder exploding.
- **When you're installing a cylinder in a manifold room, there are unique precautions you need to take.**
- **After a cylinder runs out of gas, you need to complete a changeover.**
 - Manifold systems have two types of changeover systems...
 - "automatic" and "manual".
- **When working with an "automatic" changeover manifold, it will automatically detect a decrease in pressure when the gas cylinder empties.**
 - It then switches to using the "backup" cylinder.
 - This way, you can replace or refill the empty cylinder without any downtime.
- **When you move the empty cylinder, be careful not to knock it into other cylinders in the manifold room.**
 - And always check for leaks as you are connecting the new cylinder to the pipeline.

- **With a “manual” manifold changeover system you have to do a little more work.**
 - First, close the valves on the empty cylinder to shut it off.
 - Then, replace it with a new cylinder.
- **Since this process takes longer and means the gas is unavailable during the changeover, you might feel rushed.**
 - But it’s important that you take your time and do things right... to ensure your, your coworkers, and the facility’s safety.
- **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.
- **To help alert you to a leak, a chemical compound named ethanethiol is often added to the gas that is stored in a cylinder.**
 - It gives odorless gases a “skunk” or “rotten egg” smell that serve as a warning when a tank is leaking.
- **But you should always test for leaks in the connection after you've installed a new cylinder into a gas delivery system as well.**
 - 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.**
 - So make sure you have a 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 very careful.**
 - First, look at the SDS for the gas that is in the cylinder, and determine its characteristics and potential hazards.
 - If necessary, have back-up personnel in place to help you.
 - And wear a self-contained breathing apparatus (SCBA) to do the work.
- **If the problem persists, you should take further action according to your facility's Emergency Action Plan.**

*** * * SUMMARY * * ***

- **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 storing, transporting, and accessing compressed gas cylinders.**
- **Be sure you understand the purpose of regulators and CGA's, and how to hook them up correctly.**
- **Know how to check cylinders, manifold connections 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... especially when you understand their hazards and how to avoid them.**
- **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!**