# COMPRESSED GAS CYLINDERS IN CONSTRUCTION

## 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 propane 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 do 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 building that is under construction.**
  - 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 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 ground or 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 compressed gas cylinders can vary from state to state.**
  - So ask your supervisor about the specific laws and regulations that apply to you.

- **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 on a construction site 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 area 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.

- **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 and transporting 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 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!**