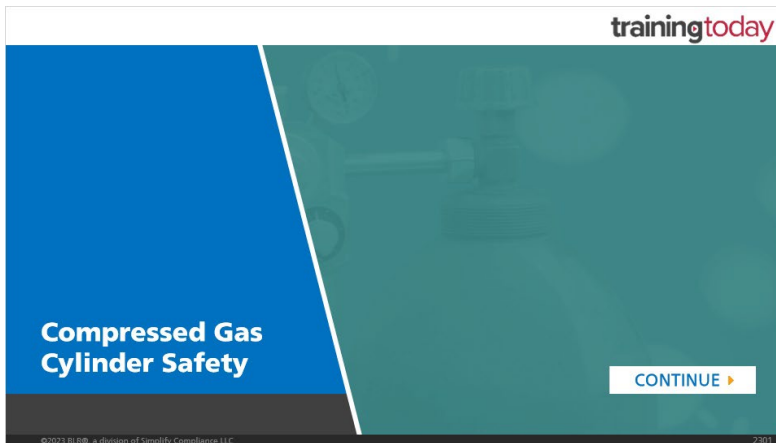


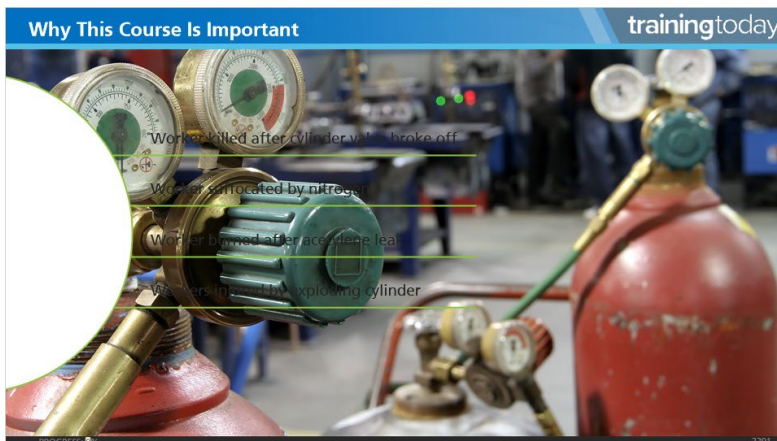
Compressed Gas Cylinder Safety

Welcome



Welcome to BLR® training.

Why This Course Is Important



Compressed gases are common and can be very useful in the workplace; however, they can also be very dangerous. Compressed gases can create environments that are explosive, reactive, flammable, oxidizing, oxygen deficient, extremely cold, corrosive, or otherwise extremely dangerous to your health and safety, depending on the product

you're using.

How many of these stories have you heard about or even witnessed?

- A worker was killed when a compressed gas cylinder turned into a rocket because the gas quickly escaped after its valve was broken off.
- A worker suffocated after entering a space filled with nitrogen.
- A facility was damaged and a worker was burned when acetylene from a leaking cylinder ignited.
- A worker was killed and his coworker was injured when a cylinder containing an unknown gas exploded while they were attempting to empty it.

Fortunately, accidents like these are preventable if you take the proper precautions.

What Are Compressed Gases?

What Are Compressed Gases? trainingtoday

- Substance is gas under normal conditions
- Many types of compressed gases
- 3 major types
 - Liquefied
 - Nonliquefied
 - Dissolved gases
- Bulk or cylinders
- Many industrial uses

- A compressed gas is a substance that is a gas at normal room temperature and pressure and is contained under pressure, usually in a cylinder.
- There are many types of compressed gases available, such as oxygen, argon, nitrogen, helium, acetylene, hydrogen, nitrous oxide, carbon dioxide, ammonia, and chlorine. Compressed air is also considered a compressed gas. Compressed gas cylinders might contain only one type of compressed gas or special blends with multiple types of gases.
- The three major types of compressed gases are liquefied gases, nonliquefied gases, and dissolved gases. Liquefied gases are liquid at normal temperatures when they are inside cylinders under pressure. Common liquefied gases are ammonia, chloride, propane, and nitrous oxide. Nonliquefied gases are also known as compressed, pressurized, or permanent gases. Oxygen, nitrogen, helium, and argon are examples of nonliquefied gases. Dissolved gases are stabilized in a cylinder by dissolving the gas in a

liquid or solid. Acetylene is a common dissolved gas.

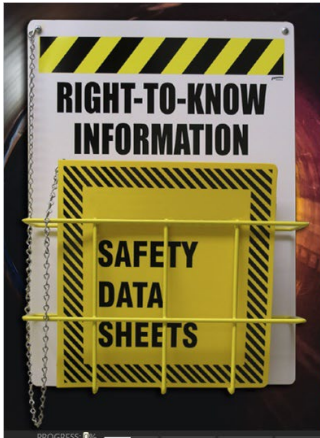
- Compressed gases can be used in bulk forms like in large storage tanks, or brought on-site in portable cylinders. Today we'll focus on working with these cylinders.
- Industries use compressed gases in many ways, including for welding and cutting, operating tools, manufacturing, and transferring liquids; as supplied air and blowing agents; and in food service, health care, and laboratories.

Hazards of Compressed Gases



- Compressed gases present both physical and chemical hazards.
- Because compressed gases are stored under high pressure, cylinders can rupture, resulting in an explosion, or valves might be damaged and fail, which would launch the cylinder.
- Because cylinders can be extremely heavy both when empty and filled, they can also damage equipment and crush feet if they fall over.
- Another significant hazard of compressed gases is the chemical characteristics of the gases themselves. They might be flammable, corrosive, toxic, oxidizing, reactive, or inert.
- Flammable gases, such as acetylene, butane, ethylene, hydrogen, and vinyl chloride, can burn or explode under certain conditions.
- Corrosive gases can burn and destroy body tissues on contact and attack and corrode metals. Common corrosive gases include ammonia, hydrogen chloride, and chlorine.

Hazards of Compressed Gases (cont.)



trainingtoday

Hazards of Compressed Gases (cont.)


- Toxic gases can cause poison atmospheres
- Oxidizing gases can react and cause fires or explosions
- Some pure gases are unstable
- Inert gases can cause suffocation
- Check the SDS for specific hazards

- Toxic gases can create poison atmospheres and cause various health problems depending on the specific gas, its concentration, the length of exposure, and the means of exposure.
- Oxidizing gases can react rapidly and violently with combustible materials such as flammable gases, flammable and combustible liquids, oils, greases, many plastics, and fabrics; finely divided metals; and other oxidizable substances. Fires or explosions can result.
- Some pure compressed gases are chemically unstable and extremely reactive. If exposed to slight temperature or pressure increases or mechanical shock, they can have violent reactions, resulting in fire or explosion. Common reactive gases are acetylene, methyl acetylene, vinyl chloride, tetrafluoroethylene, and vinyl fluoride.
- Inert gases are not toxic and do not burn or explode. However, they can cause injury or death by suffocation if they are present in high concentrations and displace enough air to reduce oxygen levels. Low oxygen levels can particularly be a problem in poorly ventilated, confined spaces. Examples of inert gases include argon, helium, neon, and nitrogen.
- Check the safety data sheet, or SDS, for a compressed gas to identify specific hazards or necessary safety precautions. We will review the hazards of some of the more common compressed gases later in this training session.

Compressed Gas Cylinder Labels

Compressed Gas Cylinder Labels trainingtoday

- Labels must identify contents and hazards
- Do not accept mislabeled or unlabeled cylinders
- Don't rely on color coding or cap labels
- Cylinders must have DOT labels if transported
- Never remove labels or markings
- Label empty cylinders with "EMPTY" or "MT"



progress 2301

- Compressed gas cylinders must be clearly labeled with information about their contents and physical and health hazards. Identification should be stenciled or stamped on the cylinder or a label. Three-part tag systems may be used for identification and inventory.
- Do not accept any cylinder that is unlabeled or mislabeled or that does not legibly identify its contents. If the labeling is unclear, mark the cylinder with the words “contents unknown” and return it to the supplier. If the labeling becomes worn over time, contact your supplier for replacement labeling or purchase the correct labeling from an approved vendor.
- Do not rely on the color of the cylinder to identify the gas. Cylinder colors vary from supplier to supplier. You should also never rely on the label on a cap because caps are interchangeable.
- Cylinders must have Department of Transportation, or DOT, labels if they are going to be transported between the vendor and your facility.
- Never remove any of the labels or markings from a cylinder.
- Once a cylinder is empty, mark or tag it with the word “EMPTY” or the letters “MT.”

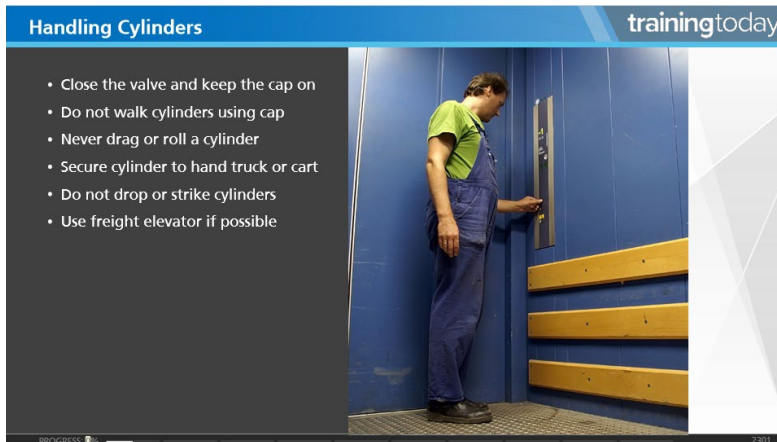
Transporting Cylinders



Transporting compressed gas cylinders properly reduces their hazards. In order to receive or prepare cylinders for shipment, you must be trained in DOT hazardous materials requirements.

- Documents called “hazardous materials manifests” or “shipping papers” are required for each shipment of hazardous materials like compressed gases. In most cases, the delivery order you receive for the cylinders is designed to comply with these requirements.
- Transport cylinders upright with the valve up. Always have the protective cap securely covering the valve when transporting a cylinder. However, never lift a cylinder by the valve cap because it is not made to carry the weight of the cylinder and could become damaged. Never transport the cylinder with the regulator in place.
- Never transport compressed gas cylinders in confined areas of vehicles, such as the passenger compartment or trunk.
- When transporting cylinders by hoist or forklift, use appropriate baskets or cradles that secure the cylinder and prevent it from banging around or falling. Never use magnets or slings to lift gas cylinders.
- Secure compressed gas cylinders to prevent movement during transport. Otherwise they can open accidentally, roll off the vehicle, or cause an explosive reaction if the gas is unstable. Make sure the vehicle is adequately equipped with racks or other ways of securing the cylinders to haul them safely.
- Do not transport cylinders containing flammable gas and oxidizing gas together or with toxic or corrosive gases. However, oxygen and acetylene cylinders may be transported together if they are transported in the truck bed below the cab level and a roll bar is installed over the truck bed to prevent the cylinders from falling out if the vehicle overturns.

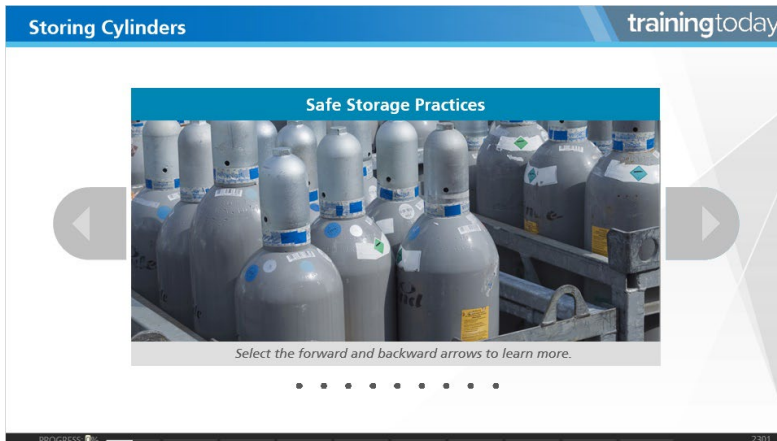
Handling Cylinders



Safe handling practices are also critical for managing the hazards of compressed gas cylinders.

- Whenever moving a cylinder, always make sure the valve is closed and the cap is on. This means that the cylinder must be detached from any equipment, and the regulator must be removed.
- Do not walk a cylinder by rocking it back and forth or rolling it along the bottom edge while holding onto the valve cap. The cap could come loose, causing you to drop the cylinder, and the exposed valve could be knocked off.
- Never drag a cylinder or roll a cylinder on its side. Not only could this damage the cylinder, it also exposes the valve and cap to the hazard of striking a solid object while the cylinder is rolling.
- Secure the cylinder to a hand truck or cart specifically designed to move cylinders. Do not handle more than one cylinder at a time unless the cart is designed for this purpose.
- Do not drop cylinders or strike them against each other or other surfaces. This could damage the cylinder or valve or cause a chemical reaction.
- If possible, use a freight elevator to transport a gas cylinder between levels of a building. If there is no freight elevator, use the common or staff elevator. Never allow other people to enter the elevator when transporting cylinders.

Storing Cylinders



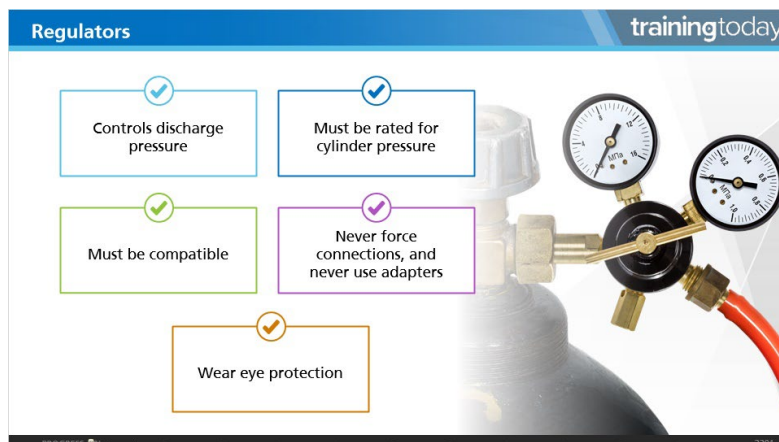
To help prevent serious injury to yourself and others, you also need to follow these safe storage practices.

Select the forward and backward arrows to learn more.

- Compressed gas cylinder storage areas must be cool, dry, well ventilated, fire-resistant, and protected from weather such as rain, snow, and direct sunlight. Do not expose cylinders to temperatures above 125 degrees Fahrenheit.
- Sparks, open flames, and smoking are not allowed near cylinder storage areas. Keep combustibles such as wood, paper, cardboard, oil, and grease away from the storage area. Remove any ignition sources such as machinery or welding areas. Do not allow a cylinder to become part of an electrical circuit. Keep fire extinguishers near the storage area that are appropriate for the gases stored there.
- Do not store cylinders in elevators, staircases, hallways, or other areas where people are often traveling or in areas where heavy moving objects may strike or fall on them. This would increase the risk of knocking over or damaging a cylinder.
- Cylinders must be separated into hazard classes when in storage. Oxidizing gases must be separated from flammable gases, and empty cylinders must be isolated from filled cylinders.
- Oxygen needs to be stored away from fuels and flammable gases, because if ignited, the oxygen will make the fire spread quickly. Oxygen cylinders must be 20 feet away from fuel sources and flammable gases or separated by a 5-foot-tall, 1/2-hour fire wall.
- Store cylinders in an upright position. Secure cylinders with straps, chains, cords or other ways to prevent them from tipping or falling over.
- Store cylinders where they are protected from the ground and dampness to prevent rusting and from tampering by unauthorized individuals.

- Make sure cylinders are stored with the valve cap on. This reduces the chance that a blow to the valve will allow gas to escape.
- Cylinder storage areas have various sign requirements depending on the type of gas being stored. Most storage areas will have “No Smoking” signs along with general “Danger,” “Caution,” or “Warning” signs.

Regulators



Before we talk about using compressed gas cylinders, let's first discuss regulators.

- A regulator is a mechanical device used to control the discharge pressure of a compressed gas from a cylinder. Never use a cylinder without a regulator.
- The regulator must be rated for the pressure that will be applied from the cylinder. Do not use a low-pressure regulator on a high-pressure cylinder.
- Regulators are gas-specific and are generally not interchangeable. Make sure that the regulator and valve fittings are compatible with the gas you will be using before installing them.
- Make sure the threads on the container valve outlet match the threads on the regulator connection or other equipment. Never force valve connections that do not fit properly, and never use adapters to fit valves to cylinders or regulators to valves.
- Wear eye protection whenever operating a regulator. Although very rare, the regulator could fail.

Using Cylinders

Using Cylinders

- Keep cylinder upright and secure
- Keep away from flames, sparks, and electricity
- No greasy, oily, or contaminated hands
- Wear appropriate PPE
- Only use cylinders for intended purpose
- Never tamper with safety devices

MORE

PENGERS 2301

Once you have found a compatible regulator, you can use a compressed gas cylinder.

- When using a cylinder, keep it upright and secure to prevent it from being knocked over. Do not remove the valve cap until the cylinder is secured. Make sure the valve handle at the top is easily accessible.
- Always keep flames, sparks, and electricity away from cylinders. If welding nearby, protect the cylinders with heat-resistant blankets or tarps.
- Do not work with cylinders when your hands or gloves are greasy, oily, or contaminated with flammable substances.
- Always wear the appropriate personal protective equipment, or PPE, when working with compressed gas cylinders. This includes eye protection and foot protection and may also include face shields, gloves, protective clothing, or respirators, depending on the hazards of the gas being used and the task being done.
- Never use a cylinder for any purpose other than its intended function of containing a compressed gas. Do not use the cylinder as a roller or some sort of support, such as a sawhorse.
- Most cylinders have one or more safety-relief devices to prevent rupture of the cylinder if internal pressure builds up to levels exceeding design limits. Never tamper with cylinder safety devices. You would be putting yourself and others in danger.

Using Cylinders (cont.)

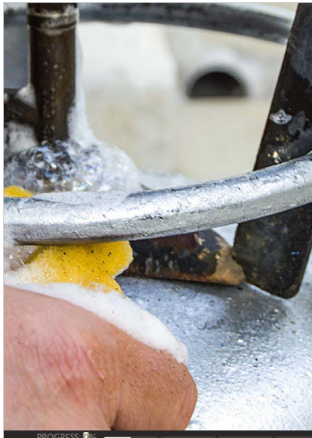
Using Cylinders
(cont.)

- Inspect cylinder, regulator, and valves
- Slowly open valve
- Never use tools to open valves
- Use fume hood with toxic gases
- Close valve, release pressure, remove regulator
- Return unused and empty cylinders



- Before using the cylinder, inspect it for obvious damage and clear labeling. All damaged or questionable cylinders or equipment should be returned to the supplier for correction or replacement. Check the regulator and cylinder valves to make sure they haven't been compromised with solvents, dirt, or lubricants like grease or oil.
- Once the proper regulator is in place, stand with the cylinder between yourself and the regulator, with the valve outlet facing away from you. Relieve the regulator's spring force by easing off the pressure adjustment screw. Open the valve slowly with your hand to the side, not above, the valve. Opening the valve quickly might put undue pressure on the regulator or other systems. Serious injury could occur if the valve were to fail when your hand is above it.
- Open the cylinder valve by hand only. Never use a hammer or wrench to open the valve. If the valve requires a tool, do not use the cylinder. You may accidentally put too much stress on the valve and cause it to break off.
- If you're working with gases that may be toxic or cause irritation, do not open the valve unless you're under a fume hood or protected by a similar ventilation device.
- Once you are done using the compressed gas, close the cylinder valve and release all pressure before removing the regulator from the cylinder. Remember not to completely empty the cylinder; always leave some residual pressure.
- Return unused and empty cylinders to the vendor for reuse or refill. Never refill cylinders or change their contents yourself. This can cause a dangerous reaction.

Leaking Cylinders



trainingtoday

Leaking Cylinders

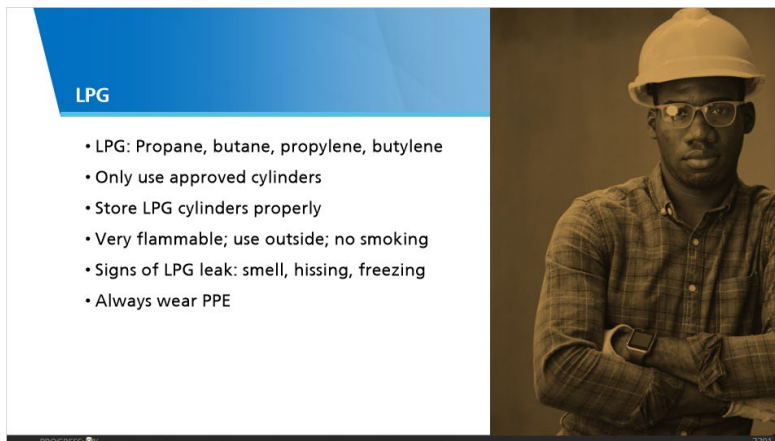
- Notify supervisor immediately
- Move leaking cylinder to ventilated area
- Post warning and tag cylinder
- Contact manufacturer/supplier and consult SDS
- Never try to repair cylinder
- Never use flame to detect leak

PROGRESS 2301

- If you notice that a gas cylinder is leaking, notify your supervisor right away.
- Move the cylinder to an isolated, well-ventilated area if it is safe to do so. If the cylinder contains a flammable or oxidizing gas, keep it away from possible ignition sources. If the gas is corrosive, direct the stream of leaking gas into an appropriate neutralizing material if safe to do so. If the gas is toxic, you may need to evacuate your facility. Call emergency service personnel if necessary.
- Post a warning about the hazard and tag the leaking cylinder as unserviceable.
- Contact the manufacturer or supplier for advice about how to handle and return the leaking cylinder. Consult the SDS if necessary.
- Never try to repair a compressed gas cylinder. If the valve is leaking, you may shut the valve and try to tighten the valve gland or nut. If it still leaks, close it and follow the steps for a leaking cylinder.
- It might seem obvious, but never use a flame to detect a gas leak. Use a mild soap solution, a compatible commercial leak test solution, or a leak detection instrument depending on the gas you are using.

If your employer has established procedures to follow in case of a leaking compressed gas cylinder, always follow those procedures, and ask your supervisor for assistance, if needed.

LPG



The slide features a blue header with the text 'LPG'. Below the header is a bulleted list of safety instructions. To the right of the list is a photograph of a man wearing a yellow hard hat, safety glasses, and a plaid shirt, standing with his arms crossed.

- LPG: Propane, butane, propylene, butylene
- Only use approved cylinders
- Store LPG cylinders properly
- Very flammable; use outside; no smoking
- Signs of LPG leak: smell, hissing, freezing
- Always wear PPE


Now that we've gone over the best practices for transporting, handling, and using all compressed gases, let's talk about specific requirements for some common gases.

- One frequently used compressed gas is LPG, which stands for "liquefied petroleum gas." The most common form of LPG is propane, but it also includes butane, propylene, and butylene. LPG is liquid while under pressure; when released it converts to gas.
- LPG cylinders must be marked as approved for LPG and labeled with their capacity and design pressure. Never use a container that is not approved for LPG use, that is corroded or damaged, or that is missing an accessory.
- Store cylinders in open-air storage units or cages with a protective roof overhead to minimize exposure to temperature increases, physical damage, and tampering. Cylinders must be kept upright unless specifically designed for horizontal use or storage. Valves must be closed and protected with screw-on caps or collars regardless of whether they are full, partially full, or empty. Make sure storage locations are provided with at least one approved portable B:C-rated fire extinguisher.
- Propane and other LPG gases are very flammable and can react with other chemicals. Always use LPG outside or in a very well-ventilated area. Never smoke when using LPG or anywhere within 25 feet of an LPG cylinder.
- Make sure you can recognize the signs of an LPG leak. LPG is heavier than air. If it leaks, it will settle in low spots such as drains or basements and can cause a fire or suffocation hazard. Although LPG is naturally colorless and odorless, you will be able to smell a leak because of a substance added to the gas. You can also detect an LPG leak from a hissing sound or freezing near the source of the leak.
- Always wear the appropriate PPE when working with LPG. It can cause cold burns if it comes in contact with the skin, so make sure to wear gloves in addition to eye protection and foot protection.

Compressed Air

Compressed Air trainingtoday

- Wear eye protection and protective clothing
- Use lowest pressure necessary
- Never use to dust off clothing
- Store hoses properly
- Compressed air \neq oxygen

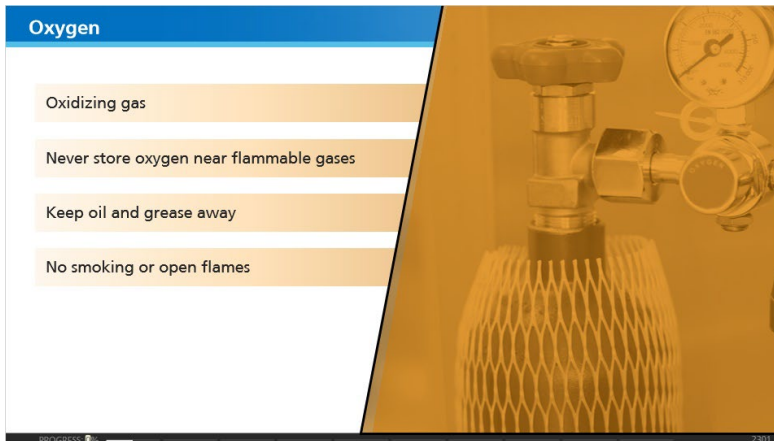


PROGRESS 7301

Compressed air is another common compressed gas. It's used in many industrial settings for operating machinery, powering air tools, or even sweeping.

- When using compressed air, always wear eye protection and protective clothing. Compressed air can cause flying fragments or debris that can penetrate your eyes or skin. Compressed air itself can also penetrate the skin or even damage your eyes and ears if used at a high enough pressure.
- Use the lowest pressure needed for the task. Air wands used for sweeping must have pressure relief valves and are limited to 30 pounds of pressure.
- Never use compressed air or any other compressed gas to dust off your clothing. This could cause an eye injury and is also a fire hazard if clothing becomes saturated with the gas and is ignited.
- Store air hoses properly. Do not allow them to lie on the ground where they can be stepped on, run over by carts or forklifts, and damaged. Inspect your air hose on a regular basis for cracks or splits.
- Do not use compressed air and oxygen interchangeably. They are not the same thing!

Oxygen



Oxygen

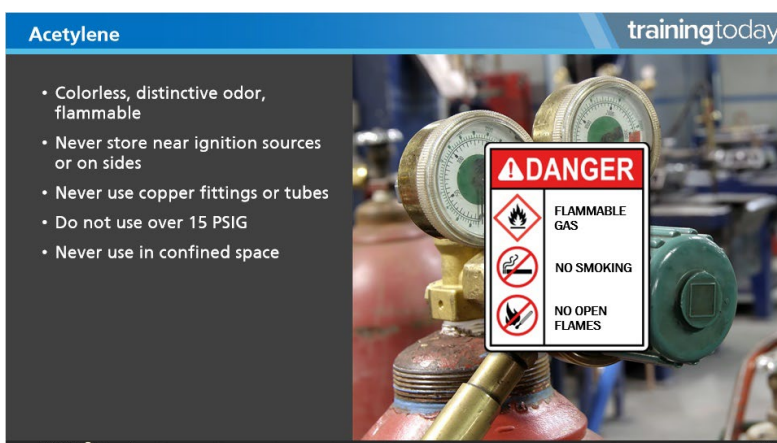
- Oxidizing gas
- Never store oxygen near flammable gases
- Keep oil and grease away
- No smoking or open flames

trainingtoday

2301

- Oxygen is an oxidizing gas. As we discussed earlier, this means that it will not burn or explode by itself, but it supports the combustion process. If it leaks near a fuel source that ignites, it will cause the flames to quickly expand.
- Consequently, never store oxygen cylinders, whether full or empty, near flammable gases. Instead, store oxygen cylinders at least 20 feet from flammables or combustibles or separate them by a 5-foot, fire-resistant barrier.
- Keep oil and grease away from oxygen cylinders, valves, and hoses. These could provide the fuel oxygen needs to start a fire. If your hands, gloves, or clothing are oily, do not handle oxygen cylinders. Never grease or oil fittings on oxygen cylinders.
- Do not smoke or use open flames in areas where oxygen is stored or used.

Acetylene



Acetylene

- Colorless, distinctive odor, flammable
- Never store near ignition sources or on sides
- Never use copper fittings or tubes
- Do not use over 15 PSIG
- Never use in confined space

DANGER

FLAMMABLE GAS

NO SMOKING

NO OPEN FLAMES

trainingtoday

2301

- Acetylene is a colorless gas with a distinctive garlic-like odor. It is very flammable and is often used for welding or cutting purposes.
- Do not store acetylene cylinders near open flames, areas where electrical sparks are generated, or any other possible sources of ignition. Post permanent signs near areas where acetylene is stored and used that include the phrases “Flammable Gas,” “No Smoking,” and “No Open Flames.” Never store acetylene cylinders on their sides.
- Never use copper fittings or tubing with acetylene cylinders. They could cause an explosion.
- To reduce the risk of explosion, do not use acetylene at an operating pressure over 15 pounds per square inch gauge, or PSIG, and do not open acetylene cylinder valves more than one-half turn of the spindle.
- Never use an acetylene cylinder in a confined space.

Other Gases



Other Gases trainingtoday

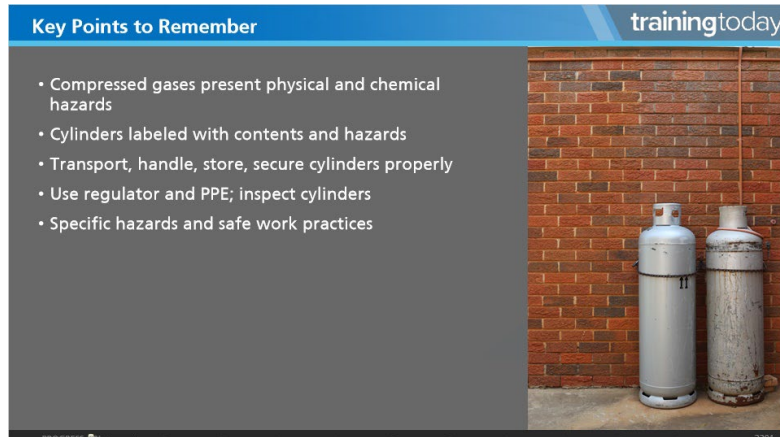
- Store inert gases in ventilated areas
- Limit exposure to corrosive gases
- Wear specialized PPE when using cryogenic gases

Inert gases such as argon, helium, and nitrogen can be deadly because they can displace air and cause suffocation.

- Store inert gases in well-ventilated areas. If a pit, a tank, or another confined space is located near a cylinder of inert compressed gas, the space could be filled with the gas if there were a leak. Before entering the space, be sure to check its oxygen level.
- When working with corrosive gases like ammonia and chlorine, limit your exposure. Use the gas in a fume hood or other vented closure if possible and avoid contact with your skin and eyes. Always wear safety goggles, but make sure you are familiar with how to use the emergency shower and eyewash station in your workplace if you are exposed. Make sure the shower and eyewash station are located within 10 seconds of where you will be using the corrosive gas.

- If you are using cryogenic gases, which can freeze skin and cause severe frostbite, wear specialized PPE like insulated gloves, rubber aprons, safety goggles or glasses, and a complete face shield. Cryogenic gases can also cause suffocation, so an oxygen meter may be required.

Key Points to Remember



The slide features a blue header with the text 'Key Points to Remember' on the left and 'trainingtoday' on the right. Below the header, on the left side, is a dark grey box containing a bulleted list of five key points. On the right side of the slide is a photograph of two grey gas cylinders standing against a red brick wall. The cylinders are of different heights and have regulators attached to their tops.

- Compressed gases present physical and chemical hazards
- Cylinders labeled with contents and hazards
- Transport, handle, store, secure cylinders properly
- Use regulator and PPE; inspect cylinders
- Specific hazards and safe work practices

We just learned a lot about compressed gas cylinder safety. But before we end this session, here are some key points for you to take away from this session about safely transporting, handling, and using compressed gas cylinders:

- Compressed gases present physical and chemical hazards and can be explosive, reactive, flammable, oxidizing, suffocating, extremely cold, corrosive, or otherwise extremely dangerous to your health and safety.
- Compressed gas cylinders must be clearly labeled with information about their contents and physical and health hazards. Never remove labels from cylinders.
- Properly transporting, handling, storing, and securing compressed gas cylinders reduces their hazards.
- Always use a regulator and wear appropriate PPE when working with compressed gas cylinders, and remember to inspect cylinders for leaks.
- LPG, compressed air, oxygen, acetylene, inert gases, corrosive gases, and cryogenic gases have unique hazards and require specific safe work practices.

This concludes the training session on Compressed Gas Cylinder Safety.