

OSHA Accident Case Studies

POWERPOINT® TRAINING



Cylinder Explosion— *The Case of the Greasy Oxygen Cylinder*

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- This training session presents a case study of an actual accident inspected and documented by the Occupational Safety and Health Administration (OSHA). The case presented in this training session is:
 - Accident: 014506299
 - Report ID: 0830500
 - Inspection: 101591337
- Today we will conduct a case study of an actual accident investigated by the Occupational Safety and Health Administration (OSHA). This is an actual tragic workplace accident that had real-life implications for the worker, the worker's family, co-workers, and the employer. The Case Study may be disturbing and may even involve a fatality.

The purpose of this training session is to teach and reinforce the importance of properly handling and storing compressed gas cylinders in our workplace in order to prevent tragic accidents. In particular, it deals with how to work with oxygen cylinders. The intention is to learn from the accident and take steps to prevent a similar accident from changing our lives.

Compressed Gases

- Highly pressurized
- Cryogenic
- Corrosive
- Toxic
- Highly reactive to oxidizers
- Flammable
- Dangerous even when inert



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- Compressed gases in cylinders are highly pressurized. If the valve or regulator of a compressed gas cylinder breaks off, the cylinder becomes a very powerful unguided missile and can even break through brick walls.
- Some compressed gases are cryogenic, which means they are very cold and cause rapid freezing. Liquid nitrogen is an example.
- Some gases are corrosive and can eat through certain metals. It is essential to use appropriate tank and pipe materials for these gases. Corrosive gases include: hydrogen chloride, hydrogen bromide, and ammonia.
- Other gases can be very toxic. Some of these gases can be detected by smell and others are odorless, which makes them especially lethal. Toxic gases include: carbon monoxide, hydrogen sulfide, phosgene, and hydrogen cyanide.
- Oxidizers such as oxygen and fluorine cause flammables and combustibles to burn more readily. Mixing regulators that once contained oxidizers or putting oil on a regulator that has been in contact with an oxidizer can result in an explosion.
- Flammable gases are used at home and in the workplace. Hydrogen and acetylene are used for welding. Propane is used for barbecues. Butane is used in gas lighters. Natural gas is used in many homes for furnaces or gas-powered fireplaces. Many of these gases have little or no odor, which means a leak could go undetected.
- Even gases that are inert and do not have any particular hazardous properties themselves can be dangerous. Nitrogen gas is nontoxic, nonflammable, and noncorrosive. However, a release of nitrogen is still dangerous because it will displace the air in an area and cause suffocation.

Take a Look at the Facts

- Employee transferring oxygen between cylinders
- Using a brass tube pigtail
- Oxygen and acetylene cylinders stored together
- Exposed oil and grease



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- In this case, an employee was transferring oxygen from a large compressed gas cylinder into a small cylinder.
- The employee was using a brass tube pigtail to transfer the oxygen.
- This transfer of oxygen was taking place adjacent to a storage area where both oxygen and acetylene cylinders were kept.
- This area also contained exposed oil and grease.

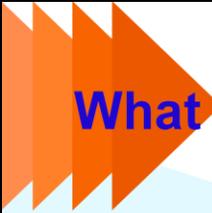
Take a Look at the Facts (cont.)

- Two other workers in immediate area
- Explosion and fire
- Three employees killed, five others injured



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- Two other employees were also working in the immediate area where the oxygen transfer was taking place.
- An explosion and fire occurred.
- All three employees in the immediate area of the oxygen transfer were killed.
- Two additional employees and three members of the public that were on the property were also seriously injured.



What Do You Think Went Wrong?

- What could have ignited the explosion and fire?
- Do you think it is safe to store oxygen and acetylene cylinders together?
- What is significant about the exposed grease and oil in the area?
- How do you think the brass tube pigtail contributed to the accident?



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Ponder these questions for a few minutes!

Let's Review the Causes

- Pigtail leaked oxygen during transfer
- Pigtail not compatible with oxygen
- Grease and oil may have been on pigtail or cylinder valves
- Acetylene is very flammable
- Smoking, welding, or a spark may have ignited the explosion



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- Since the accident report does not specifically say what caused the explosion, we will discuss some of the possible causes.
- It is likely that the brass tube pigtail leaked oxygen during the transfer from the large cylinder to the small cylinder. This could have occurred because the pigtail was not rated for the high pressure that was contained in the large cylinder, and it leaked. Or, the pigtail may not have been adequately tightened, and it leaked through a seal. Oxygen will not burn or explode by itself. Oxygen is not a fuel, it merely supports the combustion process. Something would have to ignite a nearby fuel source for the leaking oxygen to help create an explosion.
- Another possibility is that the pigtail was intended to transfer acetylene only and it was not supposed to be used to transfer oxygen. If this was the case, the pigtail could have contained remnants of acetylene gas – oxygen can be explosive when combined with acetylene gas. Or, the thread sealant may not have been compatible with oxygen and actually reacted with the oxygen. It is very important not to exchange a gauge or pigtail from one gas to another. The results could be disastrous.
- With the exposed grease and oil nearby, it is also likely that the pigtail, cylinder valves, or even the cylinders themselves were contaminated with grease or oil from the worker's hands. This grease or oil could have provided the necessary fuel that the leaking oxygen needed.
- Acetylene is a very flammable gas that is often used for welding or torch cutting operations. Most acetylene cylinders are equipped with pressure relief valves to prevent the cylinder from exploding when exposed to high temperatures. Instead, the pressure relief valve will release acetylene when heated up, which adds fuel to the fire.
- The scene is set for a fire – we have leaking oxygen and plenty of fuel sources. Now all that is needed is an ignition source. Since we do not know what the other two workers in the immediate area were doing, we can speculate that their activities may have contributed to igniting the explosion. They could have been welding, or smoking, or using a hammer to bend a piece of metal – thus causing a spark. Even static electricity could have ignited this fire.
- Can you think of any other causes that may have contributed to this accident?

Let's Talk About Cylinder Storage

- Dry and well ventilated
- Away from combustibles, heat sources, and electrical systems
- No sparks, smoking, or open flames
- Oxygen 20 feet away from fuels
- Cylinders upright, secure, valves capped
- “Danger” & “Warning” signs prominently posted



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- Cylinder storage areas must be dry and protected from the weather, including rain, snow, and direct sunlight. The storage area must also be well ventilated to prevent the accumulation of gases if there is a leak.
- Storage areas must be away from combustibles such as wood pallets, cardboard boxes, or rags. Keep heat sources away from cylinder storage areas. Keep cylinders away from electrical systems so they do not accidentally become part of an electrical current.
- Sparks, open flames, and smoking should not be allowed within 25 feet of cylinder storage areas.
- Oxygen cylinders must be stored at least 20 feet away from cylinders containing fuels such as acetylene or other fuels such as grease and oil. In fact, combustibles such as grease and oil must not be allowed in cylinder storage areas. It may be necessary to erect a fire wall between the oxygen cylinders and the cylinders containing fuels.
- Store cylinders standing upright. Make sure the cylinders are secured so they cannot be accidentally knocked over. Make sure all valves are capped to prevent the valve from being damaged if a cylinder does get knocked over.
- Cylinder storage areas also have sign requirements that depend on the type of compressed gas being stored. Most cylinder storage areas will have signs such as “No smoking, open flames, or sparks” or “Danger– Compressed Gases.”

Using Compressed Gas

- Keep cylinders upright and secure
- Keep away from flames, sparks, electricity
- Keep oil, grease, solvents off cylinders
- Open valves slowly by hand
- Don't tamper with safety devices



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- Always use cylinders in the upright position. If you need to transport cylinders, do so by securing them in carts or hand trucks specifically designed for this purpose. It is important to make sure they do not fall over and damage their valve.
- When in use, keep cylinders away from open flames, sparks, smoking, electricity, and other sources of ignition.
- Do not work with cylinders when your hands or gloves are contaminated with grease, oil, solvents, or other fuel sources. It is important to keep cylinders free of oil, grease, and solvents – especially oxygen cylinders.
- Open cylinder valves slowly by hand. If a tool is needed to open a valve, do not use the cylinder because the use of a tool may put too much stress on the valve and break it off. Open the valve slowly to prevent putting a surge of pressure on the regulator and other systems.
- Never tamper with any cylinder safety devices. You are only putting yourself and others in danger.

Don't Let It Happen to You

- Store gas cylinders properly
- Use proper regulators and pigtails
- Make sure all fittings are sealed
- Keep fuel sources away
- Keep ignition sources away from cylinders



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Let's take a look at what we can do to prevent a similar incident from happening at our facility.

- Store compressed gas cylinders properly. Be sure to separate oxygen cylinders from cylinders containing flammable or combustible gases.
- Use the proper regulators and pigtails. Do not share them between different gases.
- Make sure all fittings on regulators, pigtails, etc., are tight and adequately sealed to prevent leaks. Also, make sure the thread sealant material is compatible with the compressed gas.
- Keep fuel sources away from where gas cylinders are used and stored.
- Keep ignition sources away from cylinders.
- Are there any questions?
- Thanks for your attention.

Quiz

1. Oxygen cylinders must be stored how far away from cylinders containing fuels?
2. Oxygen is dangerous because it will explode or burn by itself. **True or False**
3. Describe one way to secure a cylinder to keep it from falling.
4. Name at least two ignition sources to keep away from cylinders.



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Background for the Trainer:

- Remind employees that the quiz is to encourage further discussion and to help you, the trainer, be sure that everyone understands what was discussed.
- Print copies of the quiz for participants to take on their own, or go over the questions as part of the training session.

Quiz (cont.)

5. Where should cylinders be stored?
6. Before handling an oxygen cylinder, make sure your hands are free of what?
7. When is it safe to share pigtails or regulators between different types of gases?
8. What is hazardous about acetylene gas?





Quiz Answers

1. Q. Oxygen cylinders must be stored how far away from cylinders containing fuels?
A. 20 feet.
2. Q. Oxygen is dangerous because it will explode or burn by itself. **True or False**
A. False, oxygen only supports combustion. It needs a fuel source and ignition source.



Quiz Answers (cont.)

3. Q. Describe one way to secure a cylinder to keep it from falling.
A. Chain or tie it to a wall.
4. Q. Name at least two ignition sources to keep away from cylinders.
A. Open flames, smoking, sparks, static electricity.
5. Q. Where should cylinders be stored?
A. In a dry and well-ventilated location.



Quiz Answers (cont.)

6. Q. Before handling an oxygen cylinder, make sure your hands are free of what?
A. Oil, grease, or solvents.
7. Q. When is it safe to share pigtails or regulators between different types of gases?
A. Never.
8. Q. What is hazardous about acetylene gas?
A. Acetylene is very flammable.

