Oxygen And Acetylene Use And Safety

AR Training
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DMME
Division of Mineral Mining
Every time you use oxygen-acetylene equipment, if certain safety guidelines are not followed, it is the same as handling live explosives ready to go off....
What is Oxygen?

- Remember; oxygen is not air!
- There is approximately 21% oxygen in normal air.
- Oxygen is found naturally in the atmosphere.
- It is produced industrially by distilling air below its freezing point.
- Pure oxygen does not burn or explode.
- Oxygen is an “accelerant”, it causes everything it comes in contact with to burn hotter and faster.
- Air has a vapor density of 1.000, Oxygen is heavier than air (1.105). This means if a oxygen bottle is leaking, the gas will settle in low areas before diffusing back into the atmosphere.
- 30% oxygen in the atmosphere will cause things to burn or explode 8 times faster!
Never use oxygen..........

• in pneumatic tools - the oil and the gas pressure friction can cause a fire or explosion.

• in oil pre-heating burners - these burners are set to burn with 21% oxygen to air ratio.

• to start internal combustion engines - gasoline is flammable enough with 21% oxygen available.

• to blow out pipelines - Leftover flammable or combustible vapors may still be present to cause an explosion.

• to dust off clothing or work area - the oxygen will remain present in the cloth fibers causing them to be more flammable.

• to create pressure.

• for ventilation.
Oxygen Storage

- Compressed.
- Stored in the pure state as a gas.
- Stored in seamless containers of drawn steel plate at 2200psi at 70°F.
- Hollow in construction, 244 cu. ft. is the standard size.
- The orifice at the top of the bottle is the diameter of the lead in a pencil (if the bottle top is damaged, the bottle can become a projectile causing injury or property damage).
Oxygen Storage

• Equipped with a high pressure valve made of Bronze.
• Valve should be completely open, if not, high pressure could cause the valve to leak.
• Valve has a safety device to drain oxygen slowly in the event of high temperatures.
What Is Acetylene?

• Acetylene is a compound of Hydrogen and Carbon ($\text{C}_2\text{H}_2$).
• Produced when calcium carbide is mixed with water.
• Needs only 10% mix of oxygen to ignite.
• It is an unstable gas, will violently decompose when in a pure state above 15 psi.
• Auto-ignition temperature is $763^\circ - 824^\circ$ F. This means if acetylene reaches 30 psi in a free state, it can explode by itself without a spark or flame being present.
• Has a burning temperature of $4,600^\circ$ F. $5,700^\circ$ F when burned with oxygen.
• Remember…. *acetylene is a very dangerous gas.*
Acetylene Storage

- Free acetylene is never stored under high pressure.
- Cylinders are packed with a porous material and saturated with acetone.
  - Acetone can absorb many times its volume in acetylene without changing the acetylene.
  - Porous filler (8-10%), Acetone (42%), Acetylene gas (36%), Reserve volume -70° F (10-12%).
  - Crushed fire brick usually serves as the “porous material”.

Figure 5-6. Acetylene cylinder construction.
Acetylene Storage

• Cylinders must always be stored upright (this prevents the acetone and acetylene from separating).
• Cylinders should remain upright to prevent the acetone from being lost (allow to sit for at least 2 hours before using if transported in a horizontal position).
• Usually are steel construction.
• Comes in various sizes.
• Valve is never opened more than one and one-half turns.
• Should not be stored below freezing (acetone may come out instead of acetylene and may clog the regulator).
• Acetylene cylinders must be refilled only by authorized gas distributors. Acetylene cylinders must never be transferred.
When The Gases Mix…..

- Oxygen and acetylene gases mixed at the correct proportions and ignited produce one of the hottest flames known.

  Up to $6300^0$ F
Rules For Handling And Using Regulators

• Be extremely careful when removing from cylinders – do not allow to remain on a bench top for any length of time.

• Never use oil or grease.

• Do not attempt to interchanges oxygen and acetylene regulators.

• Check adjusting screw before opening cylinder valve.
Rules For Handling And Using Regulators

• Crack cylinder valves before attaching the regulators.
• If a regulator creeps, have it repaired immediately.
• If the gauge doesn’t return to zero when pressure is released, have it repaired.
• Keep tight connections between the regulator and the cylinder.
• Have a qualified repair person check the regulator if it does not function properly.
Warning!!!!!

Never stand in front of, or behind, a regulator when opening the cylinder valve!
The internal working parts of the regulator are precision units. Only qualified technicians should clean or repair a regulator!

The Low Pressure Gauge
* Indicates the delivery pressure to the hoses & torch.

The High Pressure Gauge
* Indicates the pressure from tank.

The Pressure Adjusting Screw
* Turning clockwise allows the gas to flow.
Turning counterclockwise reduces or stops the gas flow.

The Inlet Connections
* Oxygen are right hand thread/Acetylene are left hand thread.
Keep free of oil, grease, & dirt!
Backfires And Flashbacks

• Backfires occur when the torch flame burns back into the torch tip and is extinguished with a loud pop.

• They occur either because the torch tip touched the work or because of insufficient gas pressure.

• They are generally harmless, however, backfires can turn into flashbacks!

• When this happens, the popping sound turns to a whistle as the gases burn back through the tip and torch head. If not stopped, the fire can travel through and damage the torch, hoses and explode the cylinder!

• A common inside diameter of oxy-fuel gas hose is 1/4 inch. If you calculate the volume of 100 feet of hose with an inside diameter of 1/4 inch, this means, should oxygen enter the fuel gas hose or should fuel gas enter the oxygen hose, a mixed gas explosion with the force potential of 20 sticks of dynamite could occur!

• Check valves and flashback arrestors help prevent this.
Check Valves

- The purpose of an internal check valve is to reduce the possibility of reverse flow gas.
- It is not intended to act as a fire stop!
- Ensure that the internal check valves are working properly by testing at least every six months, more often if the hoses are frequently removed from the torch.

**Diagram Notes**

- Spring activated: Once flow pressure decreases, valve will close preventing back flow of gas.
Flashback Arrestors

- Flashback arrestors are designed to prevent a flashback from reaching upstream equipment.

- They offer added safety and often include reverse flow check valves in a single unit.
Keep Flashbacks And Backfires To A Minimum!!

- Avoid leaks and loose connections.
- Keep tips clean.
- Maintain proper gas pressures, never starve a tip.
- Avoid overheating the metal and tip.
- Do not dip luminous cone in the molten pool.
- Watch for and repair or replace damaged equipment.

If a flashback occurs, immediately turn off the oxygen, then the acetylene and allow the torch unit to cool. Check for damage and make repairs as needed!!
The Hoses

• The hoses are usually color coded:
  – Oxygen (green)
  – Acetylene (red)

* Be careful not to use other types of hoses!!

• They are neoprene over braided inner section.
  – Be careful around sharp objects, they can be cut very easily.

• They are constructed of flame retardant materials, but will burn if there is a flashback or exposed to sustained heat.

• Hoses are graded.
  – Make sure you are using the right hose for the right gas.
More Hose Stuff

• Keep hoses clear of any falling metal, slag or sparks.

• Never allow hoses to become coated with oil, grease or dirt. Such coatings could conceal damaged areas.

• Examine the hoses before attaching to torch handle or regulators.

• If cuts, burns or damaged fittings are found, replace the hose.

• Completely replace hose if it contains multiple splices or when cracks or severe wear is noticed.
Cutting Tips And Nozzles

• Always make sure your equipment is rated for the size tip you have selected.

• A tip with too much capacity for the equipment can starve or choke the tip. This causes overheating of the head and a flashback may result.

• A damaged seating surface on either the tip or the head can create a dangerous condition, resulting in a fire or flashback. This may damage the cutting attachment.

• If the seating surface of a tip becomes damaged, DO NOT use it. Discard the damaged tip.

• If the head requires repair, take the torch to a qualified repair technician.
• Never starve or choke a multi-flame heating nozzle. This causes overheating of the head and a flashback may result.

• Should a flashback occur (flame disappears and/or a hissing sound is heard, the flame is burning inside the nozzle), immediately turn off the oxygen valve on the torch handle. Then, turn off the fuel valve.

• Allow the nozzle to cool before using.

• If a flashback reoccurs, have the apparatus checked by a qualified technician before using again.
What tip sizes do I use and what pressures do I set on my regulators?

- Tip sizes and regulator settings are dependent on the thickness of the material to be worked and the type of torch being used.

Always refer to the manufacture’s supplied cutting chart for the cutting tips you are using!!!

- Remember... if you do not use the proper oxygen to acetylene ratio, you may cause an accident, at the very least you will waste gas, which costs $$$$.
Safety Equipment And Preparations

Proper Eye protection

Appropriate gloves

Clothing and equipment free of grease & oil

Clean and well ventilated work area

Fire extinguisher

*Always remember proper task training!*
General Safety Tips

• Work under the supervision of trained and qualified personnel when appropriate.
• Always use proper PPE (shield, goggles, gloves, clothing, etc.)
• Always work in a well ventilated area.
• Keep regulators free of oil, grease and other flammable substances.
• Use the proper regulator for each specific gas.
• Never mix equipment brands.
• Always keep cylinders in an upright position.
More “Hot Tips”

- Oxygen cylinder valves must be opened all the way.
- Do not open acetylene cylinder valves more than 1 turn (1/4 to 1/3 is usually enough).
- Turn pressures into gauges gradually.
- Always use an approved friction striker, never use matches or a cigarette lighter.
- Check pressures carefully:
  - Welding - 5 psi Acet/5 psi Oxy
  - Cutting - 5 psi Acet/20 psi Oxy
Even More

- Use care that hoses are not damaged,
  - Watch where hoses are when cutting.
- Keep cylinders away from fire.
- Extinguish the torch flame by closing the acetylene valve first and then the oxygen.
- Do not relight flames on hot metal in a small confined space.
- Purge the lines before and after usage.
- Be ready to put out any fire promptly.
And Finally……

• Never attempt to transfer acetylene from one cylinder to another.

• Check valves stop reverse gas flow, *they do not act as a fire stop.* Flashback arrestors serve this purpose.

• Only a qualified technician should repair a regulator.
Do You See A Problem?

Line Pressure Gauge Failure!
What Should Be Done?

The cylinder is damaged. It should be taken out of service immediately!

An electric arc can cause an oxygen bottle to explode (the carbon in the steel will atomize into a fuel).
Anything Wrong Here?

Unsecured Cylinder
Never allow a tank to go completely empty, this may allow the gases to mix by traveling into the other lines or bottle!
A Few Last Reminders.....

- Wear flame resistant clothing, protective gloves, sleeves, aprons and safety shoes to protect skin and clothing from sparks and slag.
- Keep collars, sleeves and pockets buttoned.
- **DO NOT** roll up sleeves or cuff pants.
Gas flames produce infrared radiation which may have a harmful effect on the skin and especially on the eyes.

Select goggles or a mask with tempered lenses shaded 5 or darker to protect your eyes from injury and provide good visibility of the work.
Ventilate welding and cutting work areas adequately.

Maintain sufficient air flow to prevent accumulation of explosive or toxic concentrations of gases.

Welding or cutting operations using certain combinations of metals, coatings, and gases generate toxic fumes. Use respiratory protection equipment in these circumstances.
Good housekeeping practices improve the safety of any work area. They are essential to the safety of welding and cutting operations due to the potential hazards involved.

Keep all welding and cutting apparatus clean and free of grease, oil, and other flammable substances.