

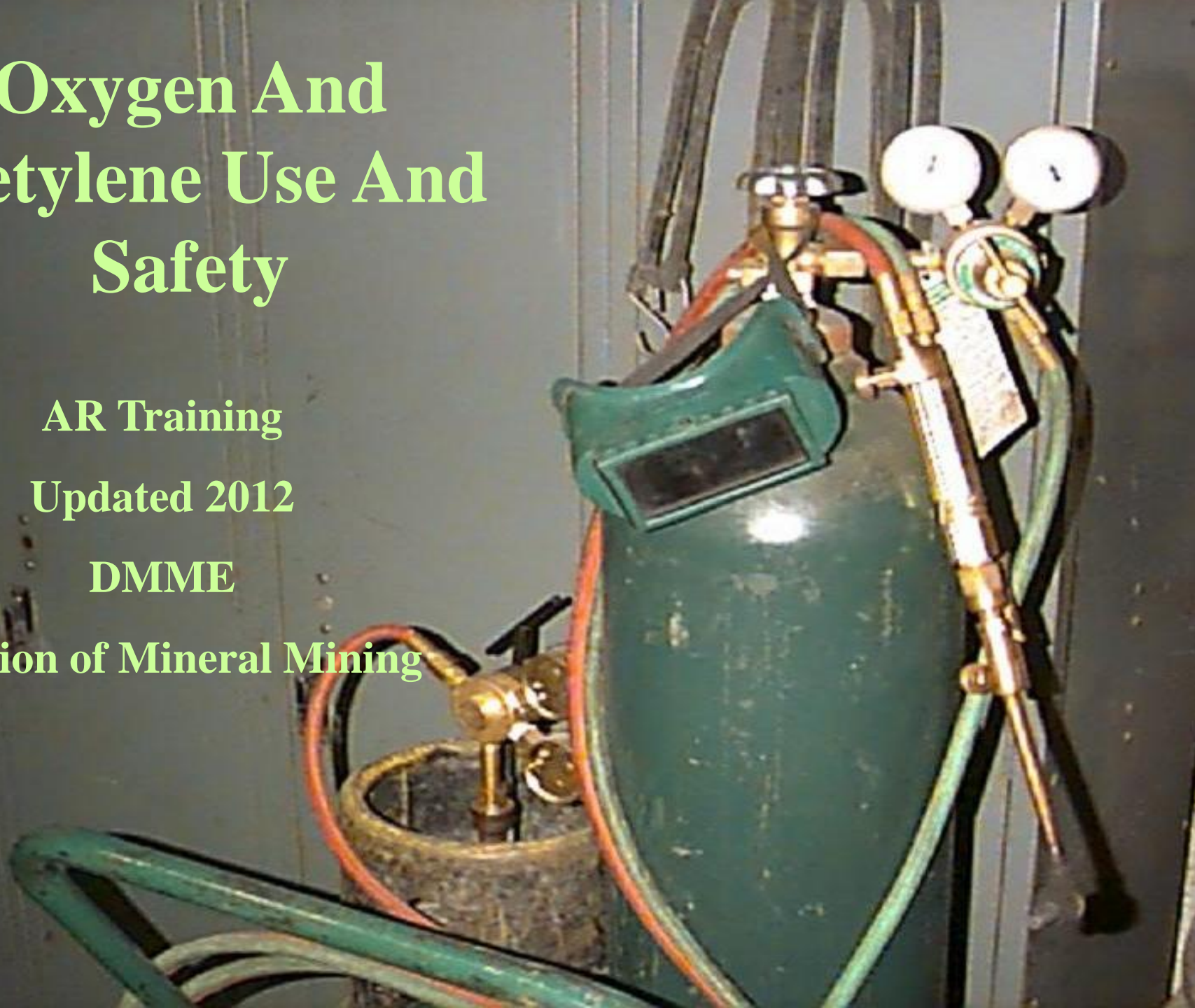
# Oxygen And Acetylene Use And Safety

AR Training

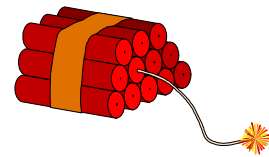
Updated 2012

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?

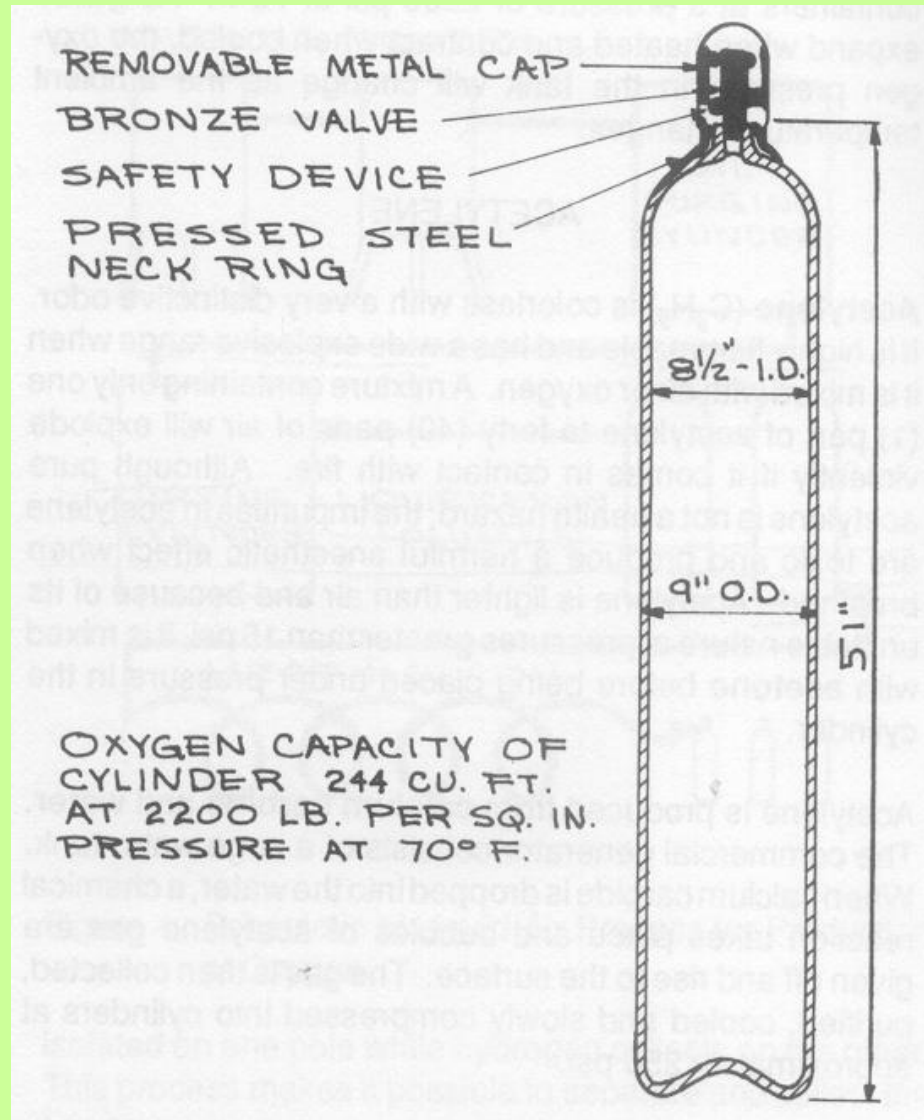
- Remember; *oxygen is not air!*
- There is approximately 21% oxygen in normal air.
- Oxygen is found naturally in the atmosphere.
- It is produced industrially by distilling air below it's freezing point.
- Pure oxygen does not burn or explode.
- Oxygen is an “accelerant”, it causes every thing it comes 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

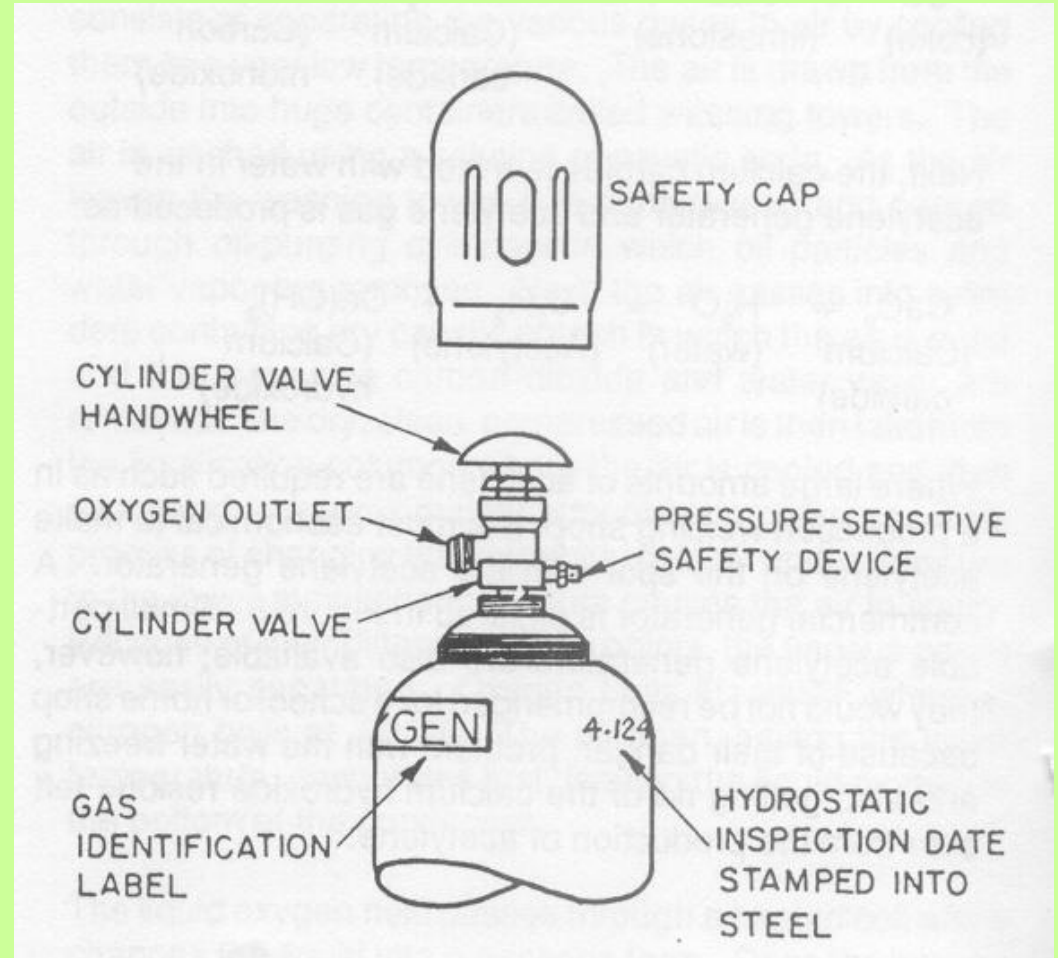
- Compressed.
- Stored in the pure state as a gas.
- Stored in seamless containers of drawn steel plate at 2200psi at 70° F.
- Hollow in construction, 244 cu. ft. is the standard size.
- The orifice at the top of the bottle is the diameter of the lead in a pencil ( if the bottle top is damaged, the bottle 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 ( $C_2H_2$ ).
- 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”.

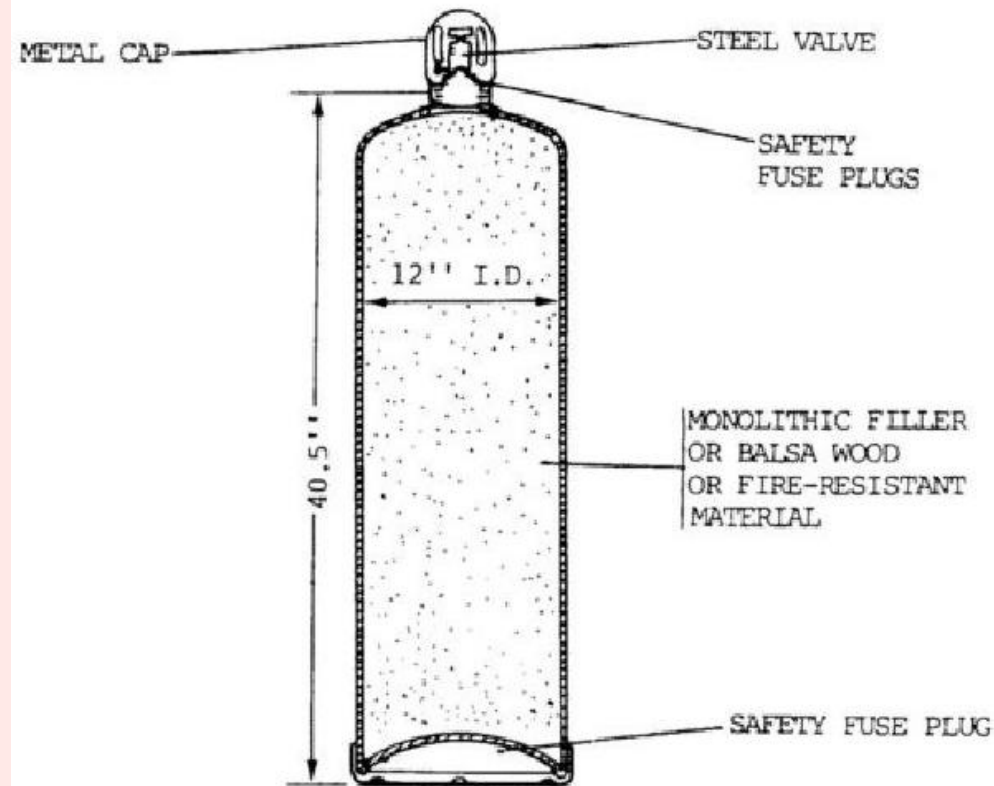


Figure 5-6. Acetylene cylinder construction.



# 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 trans-filled.

# 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° 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 interchange 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.

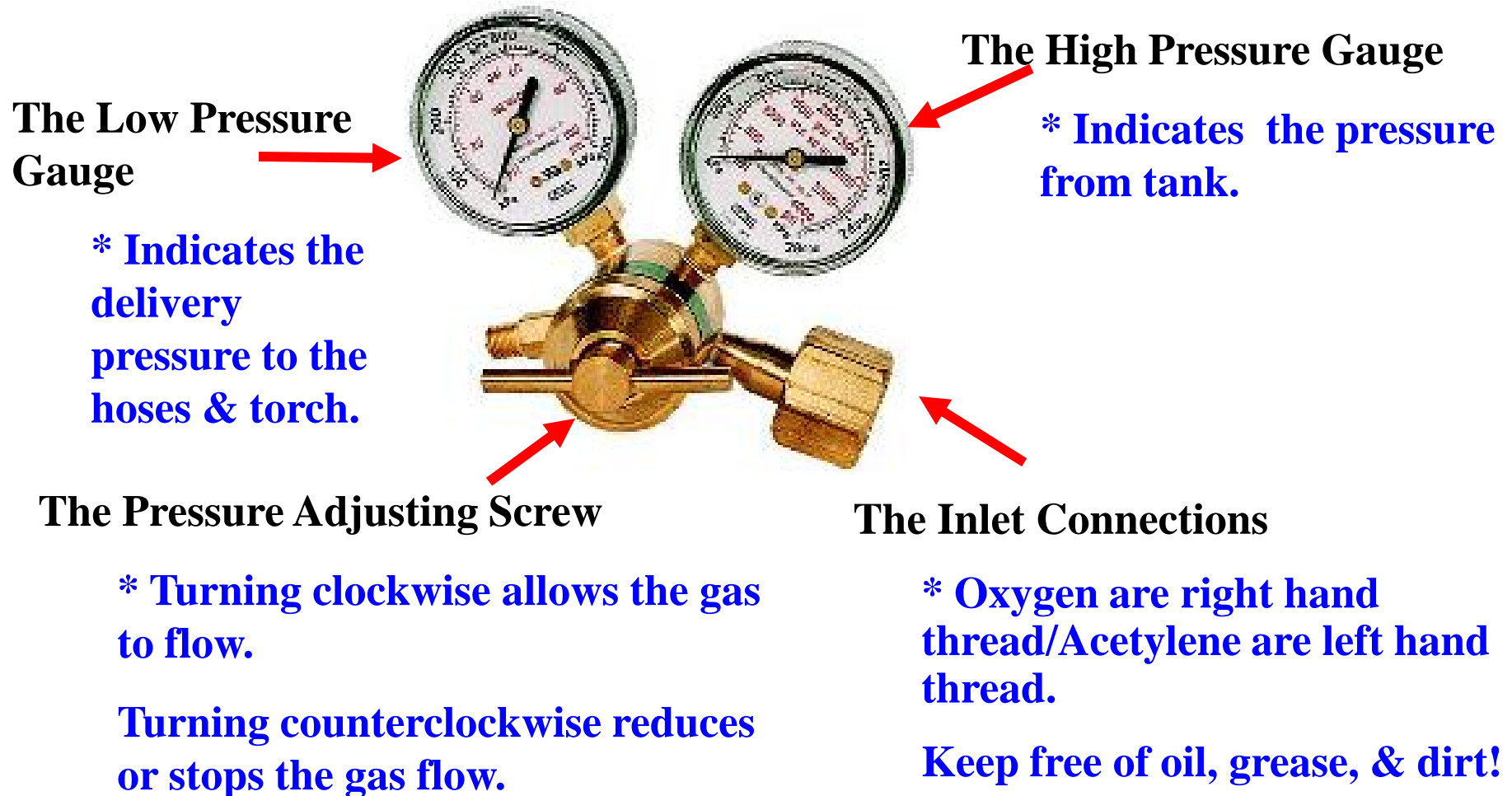


# Warning!!!!!!



*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!***





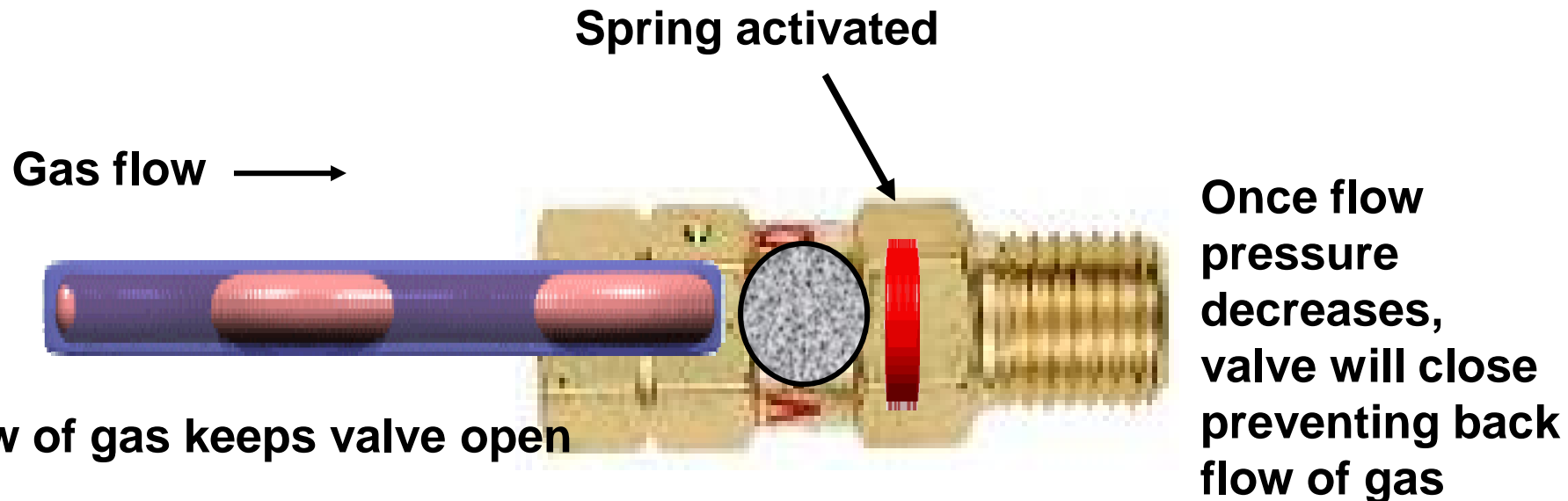
# Backfires And Flashbacks



- 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.



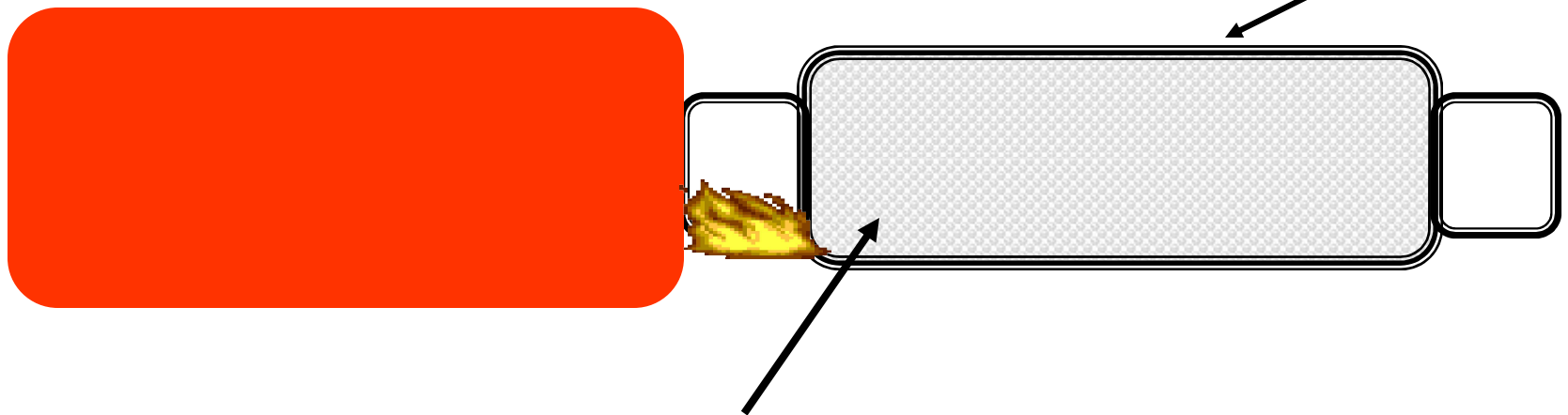
# Flashback Arrestors



- 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.

**Torch handle**

**Arrestor**



**Flame is extinguished by  
meshed material inside**

# 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.



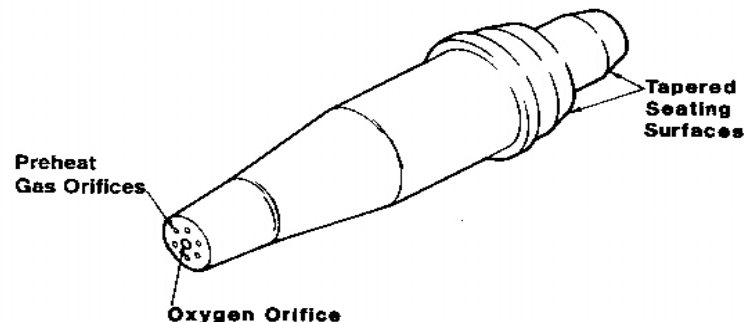
# Cutting Tips And Nozzles

- 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.



# Cutting Tips And Nozzles

- 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.

TYPES 1-101, 3-1-1 & 5-101 (Oxy-Acetylene)

Metal Thickness	Tip Size	Cutting Oxygen		Pre-heat Oxygen* PSIG	Acetylene		Speed FPM	Kerf Width
		Pressure*** PSIG	Flow*** SCFH		Pressure PSIG	Flow SCFH		
1/8"	000	20-25	20-25	3-5	3-5	6-11	20-30	.04
1/4"	00	20-25	30-35	3-5	3-5	6-11	20-28	.05
3/8"	0	25-30	55-60	3-5	3-5	6-11	18-26	.06
1/2"	0	30-35	60-65	3-6	3-5	9-16	16-22	.06
3/4"	1	30-35	80-85	4-7	3-5	8-13	15-20	.07
1"	2	35-40	140-160	4-8	3-6	10-18	13-18	.09
2"	3	40-45	210-240	5-10	4-8	14-24	10-12	.11
3"	4	40-50	280-320	5-10	5-11	18-28	10-12	.12
4"	5	45-55	390-450	6-12	6-13	22-30	6-9	.15
6"	6**	45-55	500-600	6-15	8-14	25-35	4-7	.15
10"	7**	45-55	700-850	6-20	10-15	25-35	3-5	.34
12"	8**	45-55	900-1050	7-25	10-15	25-35	3-4	.41

\*Applicable for 3-hose machine cutting torches only. With a two hose cutting torch, preheat pressure is set by the cutting oxygen.

\*\*For best results use ST 1600C-ST 1900C series torches and 3/8" hose using tip size 6 and larger

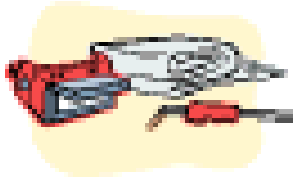
\*\*\*All pressures are measured at the regulator using 25' x 1/4" hose through tip size 5, and 25' x 3/8" hose for tip size 6 and larger.

**⚠ WARNING** At no time should the withdrawal rate of an individual acetylene cylinder exceed 1/7 of the cylinder contents per hour. If additional flow capacity is required, use an acetylene manifold system of sufficient size to supply the necessary volume.

*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

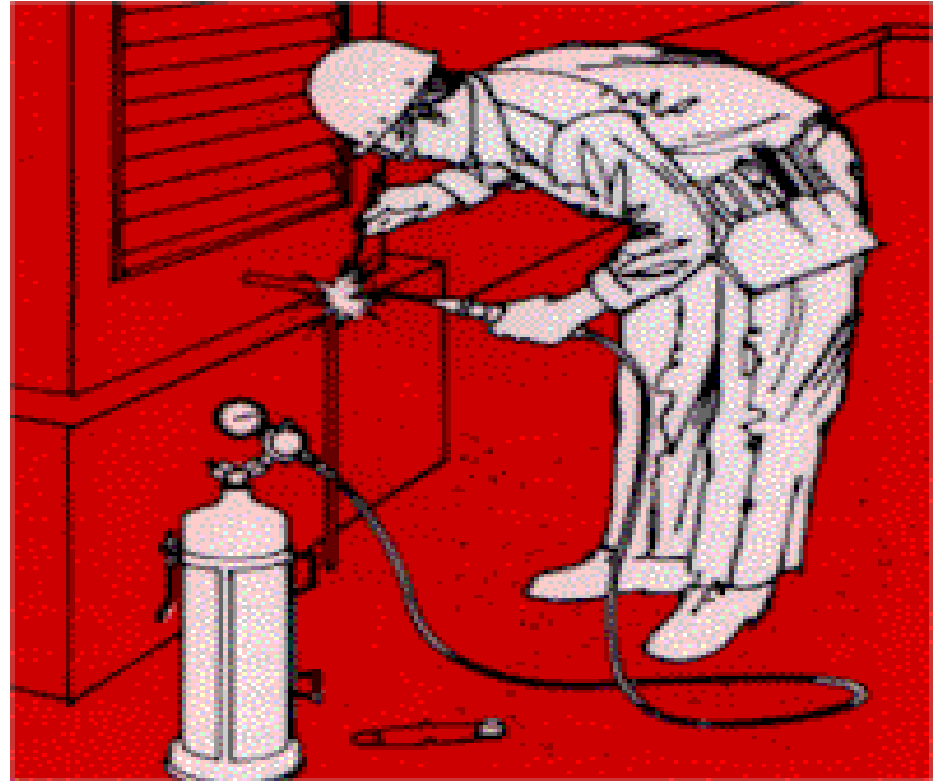


- Use care that hoses are not damaged,
  - Watch where hoses are when cutting.
- Keep cylinders away from fire.
- Extinguish the torch flame by closing the acetylene valve first and then the oxygen.
- Do not relight flames on hot metal in a small confined space.
- Purge the lines before and after usage.
- 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!**



**Electrical arc  
damage**

**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**

# What Needs To Be Done Here?



*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.

# And....

- 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.

