Oxygen-Acetylene Cutting Operations

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Oxy-acetylene torches are used for field cutting and shaping metal in the construction of cave gates. Torches are portable, easily used, and can provide years of safe trouble free service if properly maintained and operated. Proper use can speed an operation by providing cleanly cut metal ready for assembly and welding.

A number of inherent hazards exist in the use of oxy-acetylene cutting torches. It is necessary that proper safety and operating procedures are understood before attempting to operate the equipment. A thorough understanding of proper and safe procedures will add efficiency to your work.

FIRE SAFETY

The work area must be fireproof. During cave gating this is not normally a problem while inside a cave, but must be considered while on the surface. Leaves, grass and other organic debris should be removed from the area where cutting operations are to take place, particularly during dry weather. During cutting operations fire can be caused by direct contact of the torch flame with combustible, or by thrown globules of molten metal or sparks. During dry conditions have water handy, and/or spray down the work area with water before the operation, and afterwards. Special care should be taken to prevent fire.

The presence of pure oxygen serves to accelerate combustion, and causes materials to burn with great intensity. Oil and grease in the presence of oxygen can ignite and burn violently. Take special precaution to make sure clothing, and cutting equipment is grease and oil free. Never use grease or oil to lubricate cutting equipment.

These simple precautions can prevent most fires and minimize the risk of injury:

1. Inspect apparatus for oil, grease or damaged parts. Do not use if grease is present or if damage is evident.

2. Never use oil or grease around any oxy-acetylene apparatus. Even a trace of oil or grease can ignite and burn in the presence of oxygen .

3. Keep flames, heat and sparks away from cylinders and hoses. Flying sparks can travel as much as 35 feet.

4. Use oxy-fuel equipment only with the gases for which it is intended.

5. Do not open an acetylene cylinder valve more than 1½ turns and preferably no more than 3/4 of a turn, so the valve can be turned off quickly if necessary.

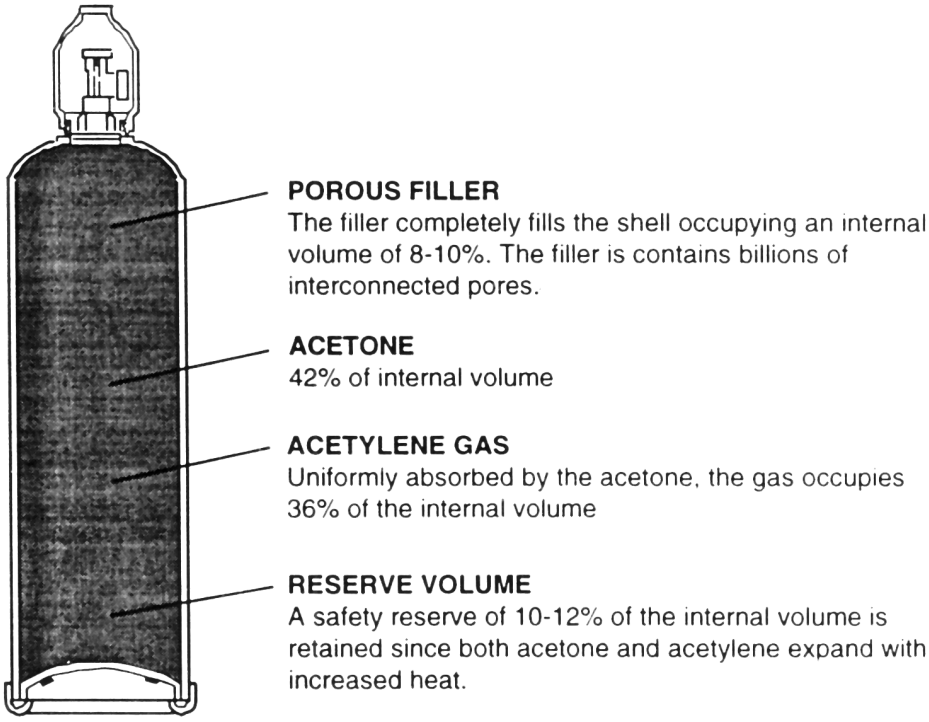
6. Never test for gas leaks with a flame. Use an approved leak-detector solution.

7. Upon completion of work, inspect the area for smoldering material or fires.

8. When not in use, or at the end of the day, close the valves on the acetylene and oxygen cylinders.

OXYGEN
Oxygen is ordinarily supplied in 244 cubic foot cylinders. Smaller and larger sizes are available. Full oxygen cylinders are normally pressurized to over 2000 pounds per square inch. The content of the oxygen cylinder can be determined by reading the high pressure gauge on the regulator. A pressure reading of 1000 pounds, for example, would indicate that half the cubic feet of gas is remaining. Due to the high pressure with which oxygen is bottled, cylinders must always be handled with care. Cylinders should never be moved without their metal caps in place, and should always be placed in a secure position when in use. Oxygen should never be used as a substitute for compressed air. The potentially violent reaction of oil, grease or other contaminants in the presence of oxygen cannot be overstated.

ACETYLENE
Acetylene is a compound of carbon and hydrogen used for cutting ferrous metals, and in a variety of other welding and heat treating operations. It is produced by the hydration of calcium carbide, or from petrochemical processes. Acetylene is compressed and stored under pressure in cylinders for transport. Acetylene becomes unstable when compressed in its gaseous state above 15 PSIG. Therefor, it cannot be stored in a hollow cylinder under high pressure the way oxygen is stored. Acetylene cylinders are filled with a porous material creating, in effect, a solid as opposed to a hollow cylinder. To fill an acetylene cylinder, the porous filling is first saturated with liquid acetone. When acetylene is pumped into the cylinder, it is absorbed by the liquid acetone, and is held in a stable condition.



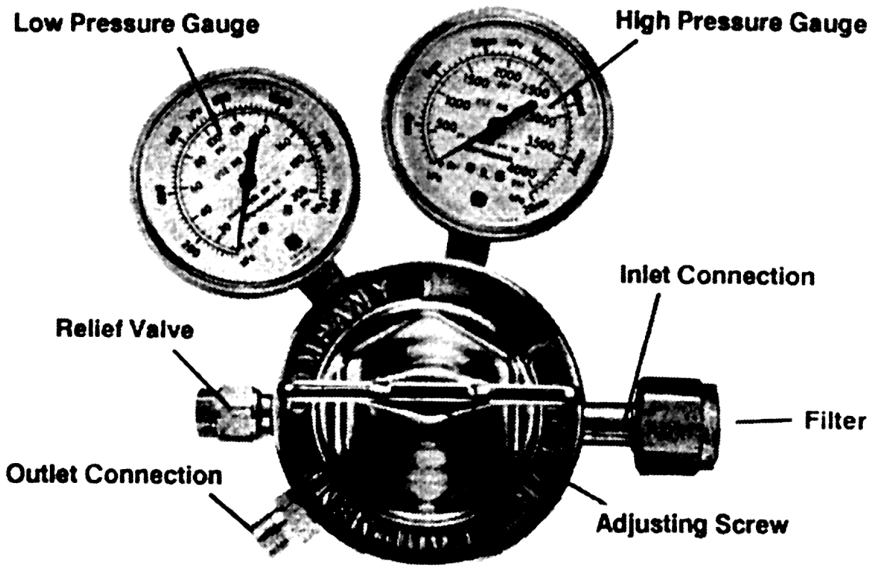
Filling an acetylene cylinder is a delicate process which can only be done safely by trained technicians using specialized equipment.

Acetylene must never be transfilled from one cylinder to another. Without proper preparation, transfilling could create an explosive situation, in the empty cylinder, when gas pressure exceeds 15 PSIG. Filling of acetylene cylinders is a delicate process requiring special equipment and training that can only be done by authorized gas distributors.

Acetylene Cylinders
Acetylene is commonly available in cylinders with capacities of 10, 40, 60, 75, 100, 130, 190, 225, 300, 330, 360, and 390 cubic feet. Larger cylinders are available for specialized industrial applications.

REGULATORS
Oxygen and fuel pressure regulators are attached to the cylinders to reduce high cylinder pressure to suitable low working pressures. Never use high pressure gases directly from the cylinder without a pressure-reducing regulator.

Regulators are connected to cylinders by their inlet connections. Special connections are provided for oxygen, and different types of fuel. Generally fuel connections have left-hand threads while oxygen connections have right-hand threads. This makes it virtually impossible to accidentally connect an apparatus to the wrong cylinder. Never attempt to change the inlet connection on a regulator in an attempt to use the regulator for a different gas type. It is imperative the correct regulator be used for the fuel type being used.



Pressure regulators reduce the supply pressure, indicated by the high pressure gauge to suitable working pressure, indicated by the low pressure gauge. By turning the adjusting screw proper working pressures can be achieved.

Pressure gauges indicate the cylinder supply pressure entering the regulator. The low pressure gauge indicates the delivery pressure from the regulator to the hose. Gauges are fragile and must be treated with care to prevent damage.

The regulators contain a pressure adjusting screw, usually a tee-handle in center of the regulator. When the adjusting screw is turned clockwise, the regulator allows gases to flow through the regulator to the hoses and the torch. The threaded adjusting screw applies mechanical force to a spring and diaphragm which controls a pressure valve in the regulator. If the adjusting screw is turned fully counterclockwise, tension on the spring is released and the regulator does not allow gas to flow.

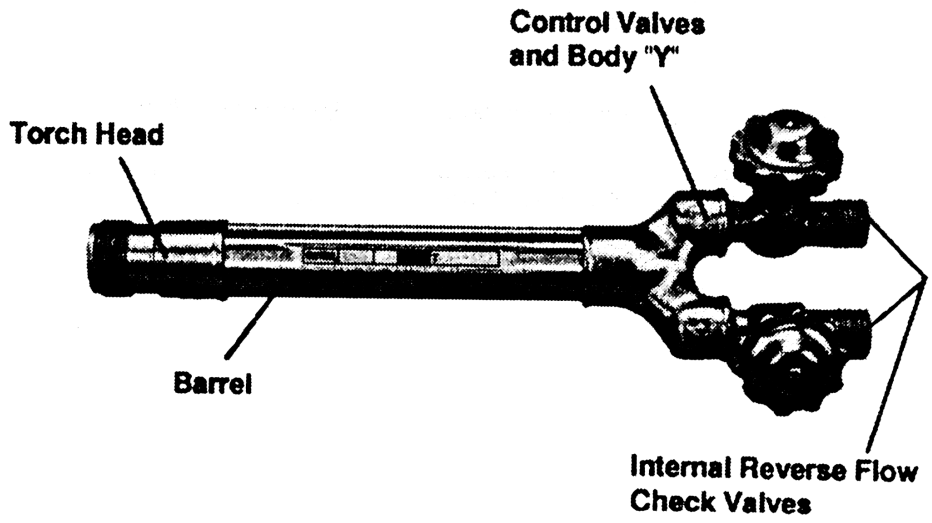
HOSES
Hoses intended for oxy-acetylene torches are color-coded for gas identification. Oxygen hoses are green and fuel hoses are red. The hose walls are constructed of continuous layers of rubber or neoprene material over a braided inner section. Most hoses are flame retardant, they will burn, but will not support a flame if the heat source is removed. As with the regulators and gas cylinders, left and right-hand thread combinations prevent connection to improper cylinders or torch valves.

Hoses are often exposed to abuse, when molten slag and sparks come into contact with the hose exterior. Falling metal can crush or cut into hoses, causing damage. The torch operator should take care to protect hoses from unnecessary abrasion or damage by keeping them away from falling metal, sparks or slag.

If cuts, burns, or worn areas are noticed on hoses they should be replaced. Over time hoses may become cracked, or coated with oil, grease or dirt. This can conceal damaged areas, requiring frequent inspection. Hoses are relatively inexpensive and should be replaced if their integrity is in question.

Torch Handle
The torch handle is a set of gas tubes with control valves. One tube controls the oxygen supply while the other controls the fuel supply. The torch handle supplies gases to the cutting apparatus where fuel and oxygen are mixed. The handle is used as a means of controlling the supply of gases.

A torch handle consists of two control valves with internal reverse flow check valves (most newer torches are equipped with check valves, but older ones may need after-market check valves added), the barrel (and tubes located inside the barrel), and the torch head.



The Torch Handle consists of oxygen and acetylene control valves, the barrel, and torch head, to which cutting and welding attachments are mated .

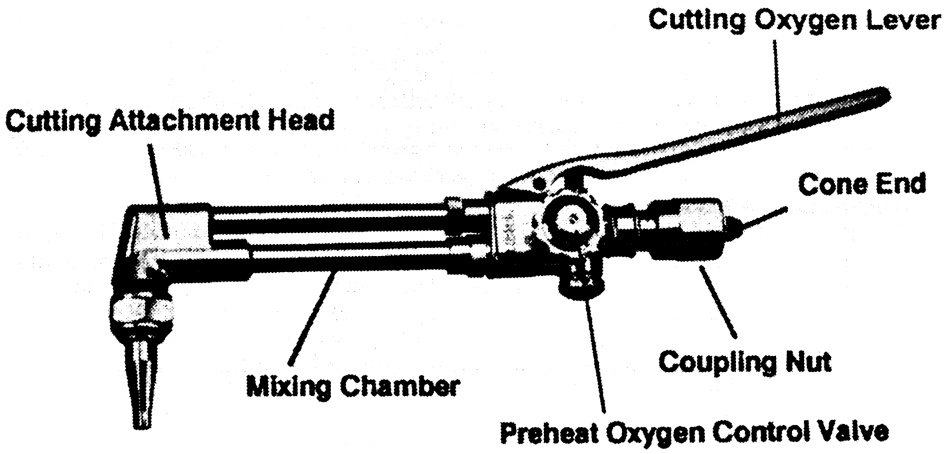
The control valves are equipped with left and right-hand threads to accept the fuel and oxygen hoses. Control valves never require lubricating. Occasionally, the packing nuts may require slight adjustment.

The torch head is the threaded portion of the handle at the end of the barrel. The oxygen supply passes though the inner tube and is directed through the center hole while the fuel passes through drilled holes

around the centered oxygen port. The inside of the torch head is a tapered recess which mate with O-rings of the cutting attachment when it is connected. The O-rings create a gas-tight seal. These surfaces should never be lubricated.

CUTTING ATTACHMENTS

The cutting attachment is connected to the torch handle, and provides the operator with a wide range of cutting capabilities. The cutting attachment consists of a cone end and coupling nut, oxygen preheat control valve, mixing chamber, a cutting lever and tube, and cutting attachment head.



The cutting attachment is attached to the torch handle by tightening the coupling nut. A wide variation of tips can be used for cutting of different thicknesses of steel.

The cone end and coupling nut are easily attached to the torch handle. O-rings in the cone head provide separation of oxygen and acetylene gases. The cutting attachment is tightened by hand only and does not require use of a wrench. Wrench tightening can damage o-rings causing a faulty seal. Remember the damaged seals on the space shuttle booster rockets, don't make the same mistake when putting on the cutting attachment. If O-rings are damaged or missing leaking and premixing of oxygen and acetylene can take place. This can lead to flashback within the torch handle or cutting attachment.

On the side of the cutting attachment is the preheat oxygen control valve which controls the preheat oxygen supply from the regulator. For preheating, the oxygen valve on the torch handle is opened completely. The furl supply is controlled by the fuel valve on the torch handle.

When these valves are opened gases are fed into a mixing chamber tube. The mixed gases flow through the preheat orifices of the cutting attachment head to the preheat orifices of the cutting tip.

The cutting oxygen lever is located above the body of the cutting attachment. When the oxygen control valve on the torch handle is open, and the lever depressed, oxygen flows through the cutting attachment head to the center of the cutting tip.

CUTTING TIP

Cutting tips are available in a variety of configurations and sizes. Cutting tips keep the preheat gas mixture and cutting oxygen stream separated and provide flame characteristics needed for a particular cutting application. Tips are sized according to the thickness of metal they can cut. For instance, a number 000 tip is designed to cut metal 1/16" to 1/8" in thickness, and a number 00 will cut metal 1/8" to

1/4" in thickness. It is important that the correct size tip be used for the cutting operation. Too small a tip used for heavy metal can cause damage to the tip from overheating, and the possibility of flashback.

Cutting tips are subject to much abuse while in use. Molten metal can spatter and adhere to the cutting tip, clogging or obstructing the gas orifices. Spatter should be removed using small round files called tip cleaners. Over time, repeated cleaning can distort the gas orifices causing irregular configuration. When this takes places the tip should be discarded and replaced.

Tip Flow Chart

Metal Thickness	Tip Size	Cutting Oxygen		Pre-heat Oxygen *(PSIG)*	Acetylene		Speed *(inches per minute)*	Kerf Width *(inches)*
		Pressure *(PSIG)*	Flow *(SCFH)*		Pressure *(PSIG)*	Flow *(SCFH)*		
1/8"	000	20–25	20–25	3–5	3–5	6–11	20–30	0.04
1/4"	00	20–25	30–35	3–5	3–5	6–11	20–28	0.05
3/8"	0	25–30	55–60	3–5	3–5	6–11	18–26	0.06
1/2"	0	30–35	60–65	3–6	3–5	9–16	16–22	0.06
3/4"	1	30–35	80–85	4–7	3–5	8–13	15–20	0.07
1"	2	35–40	140–160	4–8	3–6	10–18	13–18	0.09
2"	3	40–45	210–240	5–10	4–8	14–24	10–12	0.11
3"	4	40–50	280–320	5–10	5–11	18–28	10–12	0.12
4"	5	45–55	390–450	6–12	6–13	22–30	6–9	0.15
6"	6	45–55	500–600	6–15	8–14	25–35	4–7	0.15
10"	7	45–55	700–850	6–20	10–15	25–35	3–5	0.34
12"	8	45–55	900–1050	7–25	10–15	25–35	3–4	0.41

Shown above are appropriate gas pressures, and cutting tip sizes, for different thicknesses of steel. For best results match the cutting tip to the thickness of steel being cut

CUTTING OPERATIONS

The oxy-acetylene cutting process consists of preheating the base metal to a bright cherry red, then directing a stream of oxygen across the area. The oxygen ignites and burns the metal, carrying away slag or oxidized residue. Oxy-0acetylene cutting can be applied to plain carbon steel, low alloy steel, and some other ferrous metals. Nonferrous metals, stainless steels and cast iron are not usually cut using oxy-acetylene equipment.

Follow these steps when preparing to use cutting equipment:

1. Check all equipment for damage, including the cutting tip holes for clogs or obstructions. Clean with appropriately sized tip cleaners as needed.

2. Select and insert an appropriately sized cutting tip in the cutting attachment head. Tighten securely with a wrench, avoiding over tightening that could damage threads. Refer to the tip flow chart for an appropriately sized tip, and regulator pressures.

3. Open oxygen valve on the torch completely.

4. Open the preheat oxygen control valve on the cutting attachment. Adjust the oxygen regulator to the desired delivery pressure.

5. Close the preheat oxygen control valve.

6. Open the fuel valve on the torch handle. Adjust the fuel regulator delivery range.

7. Close the fuel control valve on the torch handle.

8. Momentarily, depress the cutting oxygen lever to purge the cutting oxygen passage.

9. Open the fuel valve on the torch handle approximately 1/8 turn and ignite the gas with a spark lighter. Be sure the spark lighter is away from the tip and not obstructing the gas flow.

10. Continue to increase the fuel supply at the torch handle until the flame stops smoking.

11. Slowly open the preheat oxygen control valve on the cutting attachment until the preheat flames establish a sharp inner cone. The configuration of the short inner cone is called the neutral flame.

12. Depress the cutting oxygen lever. If the preheat flame changes slightly to a carburizing flame, continue to depress the cutting oxygen lever. increase the preheat oxygen at the cutting attachment until the preheat flames are again neutral. If the preheat flames are not the same size and the cutting oxygen not straight, turn off the torch. Let it cool. Clean the tip.

13. Hold the cutting attachment or torch handle comfortably in both hands. Stabilize the torch with one hand. Position the cutting tip preheat flames approximately 1/8" from the metal to be cut. The other hand is free to depress the cutting oxygen lever.

14. Direct the preheat flame to the spot where you want to start the cut. Before the cutting action can start, preheat the base metal to a bright cherry red. When the red spot appears, depress the cutting oxygen lever slowly and fully.

15. When the cut starts, move the torch in the direction you wish to cut. Move the flame at a steady rate. Moving the flame too slowly allows the cut to fuse together, while moving it too fast will not preheat the metal and the cut will be lost.

16. Continue to depress the cutting oxygen lever past the final edge of the metal for a good cut.

17. A hole can be started (a piercing cut) in the center of a piece of metal by first preheating a small spot to a bright cherry red. Next tilt the torch slightly to one side to prevent sparks and slag from blowing towards you. When the metal is pierced, straighten the torch and move it steadily in the direction you wish to cut.

CUTTING SAFETY

If you experience a backfire or flashback (flame disappears and/or a shrill hissing sound when the flame is burning inside the cutting attachment) turn off the preheat oxygen control valve on the cutting attachment. Then turn off the preheat oxygen control valve on the cutting attachment. Next turn off the torch handle fuel valve. Allow the cutting attachment to cool before attempting to re-light. If backfire and flashback occurs, have the apparatus checked by a repair technician before using again.

Following use of the torch the fuel and oxygen lines should be drained of gases. First close the valves on the tanks, then allow open the oxygen valve on the torch handle ½ turn. Close the oxygen valve then repeat with the fuel valve in a similar manner. Allow about ten seconds for each 25 feet of hose.

While engaged in cutting operations wear protective clothing and use goggles to shield the eyes from flame brilliance and spattering slag and metal. Make sure your clothing has no frayed spots that could be ignited by sparks. Leather boots should be high and well covered by pants legs to prevent slag from entering boot tops. Synthetic material used in boots such as nylon or Gortex should be avoided since hot metal will quickly melt through these fabrics causing damage to the boots and potential injury. Hands should be protected by leather gloves.