Oxy-Acetylene Welding

Oxy-Acetylene (OA) welding is one of the many types of welding supported by the PRL. It is extremely versatile, and with enough skill and practice you can use this type of welding for virtually any metal. In fact, the oxy-acetylene flame burns at 6000 °F, and is the only gas flame that is hot enough to melt all commercial metals. Oxy-acetylene welding is simple in concept - two pieces of metal are brought together, and the touching edges are melted by the flame with or without the addition of filler rod. This document will help you get started welding using the oxy-acetylene set-up. Read the steps below to get a feel for what is going on, and then get a shop TA to walk you through the process the first time.

Advantages of Oxy-Acetylene Welding :

- It's easy to learn.
- The equipment is cheaper than most other types of welding rigs (e.g. TIG welding)
- The equipment is more portable than most other types of welding rigs (e.g. TIG welding)
- OA equipment can also be used to "flame-cut" large pieces of material.

Disadvantages of Oxy-Acetylene Welding :

- OA weld lines are much rougher in appearance than other kinds of welds, and require more finishing if neatness is required.
- OA welds have large heat affected zones (areas around the weld line that have had their mechanical properties adversely affected by the welding process)

Materials Suitable for OA Welding in the PRL:

Most steels
Brass

Preparation :

1) Assemble all of the materials needed to make the weld. This includes parts, OA equipment, fixturing, tools, safety mask, gloves, and filler rod.
2) Clean the parts to be welded to remove any oil, rust, or other contaminants. Use a wire brush if needed to remove any rust.
3) Assemble and fixture the parts in place - the parts need to be stable for a good weld line. Ceramic bricks, vise grips, pliers, and clamps are available in a file cabinet in the weld room for fixturing.
4) Select the nozzle you plan to use for welding. Nozzles come in a variety of sizes, from 000 (for a very small flame - typically used for thin materials) to upwards of 3 (for a large flame - needed for thick materials). Larger nozzles produce larger flames and, in general, are more appropriate for thicker material. Choosing the right size nozzle becomes easier with more experience. Ask a TA or make some test welds to determine if you are using the right size nozzle.
5) Clean the nozzle. Carbon deposits can build up on the nozzles which interfere with flame quality and cause backfiring. The cleaning tool has a wide flat blade (with a file-like surface) which is used to clean carbon deposits on the exterior of the nozzle.

Use it to scrape any deposits from the flat face of the tip. Use the wire-like files to clean the interior of the nozzle. Pick the largest wire which will fit inside the nozzle, and the scrape the edges of the hole to remove any carbon buildup.

6) Attach the nozzle to the gas feed line by hand. Don't over-torque - the nozzle and hose fitting are both made of brass which doesn't stand up well to abuse. A snug, finger tight fit is the sufficient.
7) Check the pressure levels in the oxygen and acetylene tanks. There should be at least 50 psi in the acetylene tank. The oxygen tank can be used until it is completely empty. If needed, ask a TA to change bottles. Note: The oxygen used in OA welding in NOT for human consumption. It contains contaminants that could be unhealthy if taken in large quantities.

Lighting the flame

1) Open the main valve on the acetylene tank ~1/2 turn. This charges the pressure regulator at the top of the tank.
2) Open the pressure regulator valve on the acetylene tank (turn clockwise to open) and adjust the pressure in the acetylene line to 5 psi. DO NOT pressurize the acetylene over 15 psi - it will explode.
3) Open the acetylene pin valve on the handle of the welding tool, letting acetylene escape. Tweak the pressure regulator valve until the regulator pressure is constant at 5 psi. Close the acetylene pin valve.
4) Open the main valve on the oxygen tank. Turn the valve until it is fully open (until it stops turning).
5) Open the pressure regulator valve on the oxygen tank (turn clockwise to open) and adjust the pressure in the oxygen line to 10 psi.
6) Open the oxygen pin valve on the handle of the welding tool, letting oxygen escape. Tweak the pressure regulator valve until the regulator pressure is constant at 10 psi. Close the oxygen pin valve.
7) Slightly open the acetylene valve (~1/8), until you can just barely hear acetylene escaping.
8) Make sure there is no person or anything flammable in the path of the nozzle. Use the striker to ignite the acetylene. The flame should be yellow and will give off a lot of soot.

Adjusting the flame

1) Open the acetylene valve further and watch the flame near the nozzle tip. Add more acetylene until the flame is just about to separate from the tip. (The flame will separate from the tip of the nozzle if you add too much acetylene.) If so, reduce the flow until the flame reattaches to the tip, and then open the valve again to the near-separation point.
2) Slightly open the oxygen pin valve. If the flame goes out, turn off the gases and try again. DO NOT try and ignite the flame with both oxygen and acetylene pin valves open. As the oxygen is added the flame will turn bluish in color.
3) The blue flame will be divided into 3 different color regions - a long yellowish tip, a blue middle section, and a whitish-blue intense inner section. There are three types of flames as described below :

- Neutral - This type of flame is the one you will use most often in the shop. It is called "neutral" because it has no chemical effect upon the metal during welding. It is achieved by mixing equal parts oxygen and acetylene and is witnessed in the flame by adjusting the oxygen flow until the middle blue section and inner whitish-blue parts merge into a single region.
- Reducing flame - If there is excess acetylene, the whitish-blue flame will be larger than the blue flame. This flame contains white hot-carbon particles, which may be dissolved during welding. This "reducing" flame will remove oxygen from iron oxides in steel.
- Oxidizing flame - If there is excess oxygen, the whitish-blue flame will be smaller than the blue flame. This flame burns hotter. A slightly oxidizing flame is used in brazing, and a more strongly oxidizing flame is used in welding certain brasses and bronzes.

Welding

1) Put on a dark faceshield to protect your eyes from the light of the flame. Make sure you have on long sleeves and all natural fibers. You can wear a leather welding jacket and/or gloves if it makes you feel more comfortable.
2) Apply the flame to the parts to begin heating. Use the region of the flame near the tip of the bluish inner region.
3) The metal will begin to glow. Continue heating both parts being welded until a small pool of welded metal appears near the edge of each of the parts. You must get molten pools on BOTH parts simultaneously to create the weld. The may require adding more heat to one side than the other, and takes some practice.
4) After the molten pools have formed on both sides of the weld, use the flame to gently stir the two pools together to form the weld. This also takes a little practice.
5) After the two pools have joined, slowly move the flame along the weld line, lengthening the pool using metal from both parts. A gentle, circular, swirling motion will help mix the molten metal from both sides as the puddle is lengthened. This process is highly dependent on the materials and part geometries being welded. Practice, practice, practice to get better control. Welding sample parts is a good idea..
6) Continue this process until the entire weld line is complete.
7) Once you're done, turn off the flame. Close the oxygen pin valve first, and then the acetylene valve. Note: Welded parts can remain hot for a LONG time.

Backfiring

Improper operation of the torch may cause the flame to go out with a loud snap or pop. This is called backfire. It is caused by one of a few things. The first thing to do is turn the gas in the torch off, check all the connections and try relighting the torch. Backfiring can be caused by touching the tip against your workpiece, overheating the tip, operating the torch at other than recommended gas pressures, by a loose tip or head or by dirt on the seat.

Shutting Down and Cleaning Up

When you're completely finished welding and are ready to quit for the day, you need to clean up.

1) With the flame extinguished and the pin valves closed, close the main valve on the oxygen tank. It should be firmly seated at the bottom.
2) Open the oxygen pin valve to bleed off all of the oxygen in the regulator and feed line. Close the pin valve once the feed line pressure has gone to zero.
3) Fully back out the oxygen regulator valve so there is no pressure in the line. DO NOT close the valve, as this will pressurize the line once the tank is open again. In the case of the acetylene, if it is pressurized over 15 psi, it may explode! If you are not sure about doing this properly, find a TA to help you.
4) Repeat steps 1 through 3 for the acetylene line.
5) Return all of the tools to their proper storage places and coil the feed lines around the handle on the gas cylinder cart. Note: Do not remove the nozzle from the feed line. The feed lines should always have a nozzle attached to prevent accidental damage to the threads used to attach the nozzle.
6) Don't forget to ask for a shop job!

revision history :

Ver 1.0	5/97	Steve Johnson	original text
Ver 1.1	6/97	Bryan Cooperrider	formatting, revisions, and additions
Ver 1.2	10/01	Katherine Kuchenbecer	minor revisions