Welding & Oxyacetylene Cutting

Do You Know The Basics?

By Pat Norton

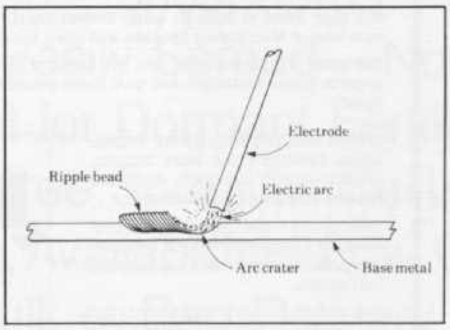
How much do you know about welding? How much do you know about oxyacetylene cutting? Do you know how to safely weld or to safely use an oxy cutting torch? Do you even think that course managers such as ourselves should "jump right in" when there's welding or cutting to be done, or should this be left to our mechanics and staff?

In this column I'll initially be talking about my past phobia with welding and/or cutting. Then I'll touch on the basics of welding - both electric arc and oxyacetylene and the basics of torch cutting. Lastly, I'll just remind everybody of the need for good, sound safety awareness when welding or cutting.

I used to be scared as hell of electric arc welding, not to mention firing up a cutting torch. Jim Love once recommended that I take a three credit welding course at the UW-Madison. Being a naive young student, I agreed to do this. I knew nothing about welding and figured that this course could help me increase my knowledge of this strange process. Taking that welding course ranks up there with my top three worst lifetime mistakes. My main memories are of strange terms like TIG, duty cycles, amperages, and MIG. (I always thought MIG referred to Soviet fighter jets!) My memories of welding lab are even worse. My electrode was either always sticking or waving harmlessly in the air, my helmet was never adjusted properly, I'd start sweating profusely, and I always imagined that my lab instructor was standing behind me saying to himself - "What is this kid doing in this class?" By the end of that class I never wanted to even look at a welding machine again. (Here! Take this! I don't want it! Get me out of here! AAAHHH!)

What I keep telling myself and my employees is that welding and cutting are not to be feared, not to be avoided. They both just take alot of practice. Don't let your mechanic do all the welding/cutting - once you get the hang of it, it's kind of fun. It's sort of like learning to operate a backhoe - fun once you learn how.

Electric arc welding, or simply arc welding, uses an electric spark created by electricity jumping across an air gap, or arc gap from the electrode, or rod, to the base metal to be welded. As electricity jumps across this gap, it creates heat which melts the base metal. The force of the arc creates a crater. Rod metal piles up at the back of the crater and cools in ripples (if you know what you're doing) to create the characteristic arc weld bead. Three variables must be properly controlled if you're going to have any chance of laying down a good bead:



Principle of the arc welder. Electricity flowing through the electrode held by the welder creates an arc as it leaps the air gap between the end of the electrode and the base metal.

1) **Angle of the electrode** - usually about 20° in the direction you want to travel.

2) **Arc gap** - the distance of the rod from the base metal should be equal to the diameter of the rod itself. If the rod is held too closely, a cold weld may result, causing the rod to stick to the metal. Holding the rod too far from the base metal causes too hot an arc due to voltage buildup, resulting in weld puddle splatter and poor control. The proper rod distance should result in a steady "frying noise" like bacon on a hot griddle.

3) **Forward movement speed** - too fast of forward movement doesn't allow much rod filler metal to be deposited, while too slow of forward movement makes the weld puddle too wide and results in burning right through the base metal.

My tendency is to always move the rod forward too fast - I get nervous and jumpy when the sparks start flying and go too fast. Slow the rod down and allow filler metal to be deposited.

There are recommended amperage ranges on any arc welding machine for each type of electrode. In general, higher amperage settings are required for thicker metals, while too low of amperage settings result in rod sticking and difficulty in striking your arc. If the amperage setting is too high, then rod and base metal will melt uncontrollably due to excessive heat buildup.

Electrode diameter has a great effect upon amperage setting. The larger the rod diameter, the greater the amperage passed through the electrode, and therefore the greater the amperage setting on the machine.

Electrodes are generally grouped into four classes:

1) **Fast-freeze group (Codes E6011, E6010)** - these are general purpose electrodes designed to give deep penetration with deposits that harden quickly. Quick freeze characteristic makes them good for overhead or vertical welding with minimal sag or drip. The E6011 and E6010 perform similarly, but if you have a simple AC welder use the E6011, not the E6010 (the flux coating on this one doesn't permit AC current use).

2) **Fill-freeze group (Codes E6012, E6013, E7014)** - produces a less penetrating arc than the fast-freeze group. Commonly used in DC straight polarity, which produces fast electrode melt and higher deposit rate. They do produce a slag covering which must be chipped off as the metal cools.

3) **Fast-fill group (Codes E6027, E6024)** - recognized mainly by the heavy iron powder flux coating the electrodes. Produce smooth beads and heavy slag deposits. Can be used in the flat down position only.

4) **Low-hydrogen group (Codes E7018, E7028)** - important where special strength is required. Produce maximum strength welds in problem steels.

Two other points to remember about electric arc welding:

1) Most welding machines will require 220 volt current and wiring in your shop. If you have only 110 volt current

(regular household current) you can get a limited amperage welding setup (up to about 90 amps). There will usually be a need for more amperage than 90 amps, either for thicker steels or for bigger electrodes.

2) Most of the steels that we encounter in our operations are easily welded. Cast iron can be welded, but requires special electrodes and special skills. Aluminums are usually brazed, I think, and in general thin metals can be pretty tricky and will need special practice.

In addition to electric arc welding, most of us are at least familiar with oxyacetylene torch cutting. The oxyacetylene cutting torch utilizes a central oxygen hole in the tip surrounded by smaller holes for the acetylene. The acetylene preheats the metal to 1200-1400° F, then a blast of pure oxygen (from the handoperated lever) actually burns up, or oxidizes the metal. A shower of hot metal and sparks gets all over the workbench, the floor and possibly yourself. Use protective eyewear, welding gloves, and long-sleeved clothing when using either the cutting torch or the arc welder.

The torch tip is angled up to 90° for making a straight cut on heavy steel plate.

The steps in lighting an oxy torch are as follows:

1) Always use a striker, never a match or cigarette lighter.

2) Open the acetylene valve slightly (red hose), then strike a spark to ignite the torch. The acetylene will burn sooty black until the oxygen is adjusted.

3) Open the acetylene adjustment valve until only a small of sooty flame is left.

4) Open the oxygen adjustment valve (green hose) to change the flame from sooty orange to blue. Adjust until you have a distinct inner cone (the hottest point) as well as an outer cone.

Steps to shut down an oxyacetylene torch:

1) Close the acetylene adjustment valve, extinguishing the flame.

2) Close the oxygen adjustment valve.

3) Close both the oxygen and the acetylene cylinders.

4) Open and bleed both red and green lines through the torch, then close adjustment valves when pressure is bled off.

Cutting torch operating pressures should be at 5 psi for acetylene and 35 psi for oxygen with your hose lines open. These operating pressures must be preset through the use of pressure regulating valves on each of your gas cylinders. These pressure settings are recommended for steel from an eighth to a half inch in thickness, which is what most of us commonly use. Steel is easily cut with the cutting torch, but other metals can present a problem. Aluminum, stainless steel, and copper are much more difficult and are usually cut by a different procedure (use a giant hacksaw, right?).

In closing, remember these common sense points:

1) Thin metals can simply be butted together and welded, while thicker metals require beveling or V-ing to allow maximum weld and heat penetration.

2) Identify the metal to be welded and make sure it is clean before it's welded.

3) Always remove the slag either with a chipping hammer or a wire brush.

4) Don't be afraid of either welding or oxyacetylene cutting, but do have a healthy respect for the danger involved. Use safety clothing and especially safety eyewear.

Welding and cutting require alot of practice, so "jump right in" and get to it!