



Tech Talk Tech Talk

Welcome to the third issue of *Tech Talk*. This newsletter covers a range of topics on various welding products, applications, metallurgy, techniques, and economics. Previous issues are archived at www.unibraze.com. Submit any questions or comments to leroy@unibraze.com or call 1-877-233-1375.

In this issue, we will look at the filler metals that fall under the AWS specification 5.2 “Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding”.

AWS A5.2-92 lists four major classifications for carbon and low alloy steel oxyfuel gas welding rods for fusion welding. They are:

R45, R60, R65 and R100

What does “R45” mean?

The “R” indicates “rod” and the two or three remaining digits designate the approximate tensile strength of the deposited weld metal in ksi (same as psi x 1000). So an R45 rod has a deposited tensile strength of 45 ksi or 45,000 psi.

Classification Details:

- R45 - Has a simple low carbon steel chemical analysis.
 - May be used to join wrought iron and low carbon steels (also known as mild steel).
 - Is a general purpose gas-welding rod.
 - The required tensile strength does not exceed 45,000 psi (310 MPa).
- R60 - Has a carbon steel chemical analysis with slightly higher carbon and manganese content.
 - Is used for carbon steels with tensile strengths up to 60,000 psi (410 MPa).
 - Is a general purpose rod of medium strength and good ductility.
 - Is also used for low alloy steels that fall into this strength range.
 - Most commonly used for carbon steel pipes in power plants, process piping and other conditions of severe service.
- R65 - Has a carbon or low alloy analysis.
 - Is used for carbon and low alloy steels with tensile strengths up to 65,000 psi (450 MPa).
- R100 - Has a low carbon steel analysis, containing additions of copper, chromium, nickel and molybdenum.
 - Is intended for the welding of alloy steels that have a minimum specified tensile strength no higher than 100,000 psi (690 MPa).

- Welds made with this class of filler metal respond to post-weld heat treatment (quench and tempering).

The remainder of this newsletter will deal with the techniques used to perform a quality oxyfuel weld.

Oxy-Acetylene Welding Techniques:

There are three main techniques used in oxyfuel welding. Two of these techniques are used to weld flat joints and one is used for all-position welding. The same type of oxyfuel welding apparatus is used in all cases, but the torch welding tip size could be changed depending on the amount of BTU heat output required. See Figure 1

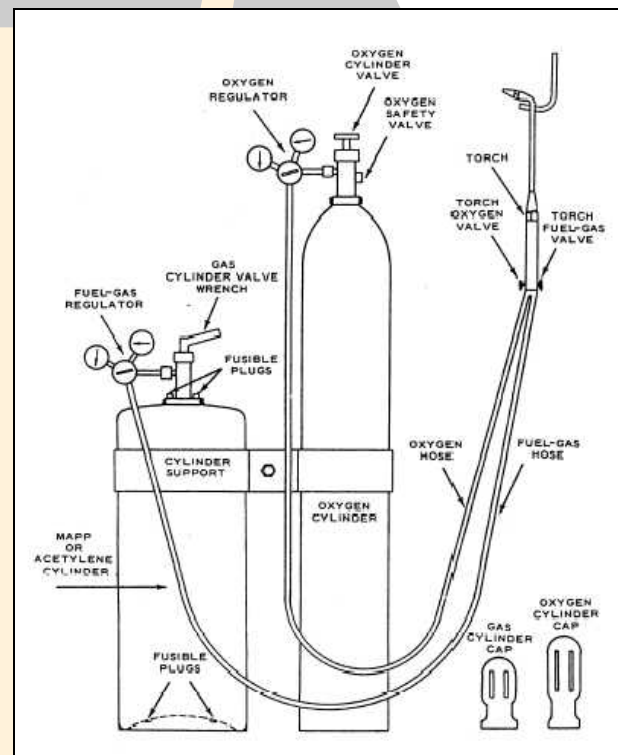


Figure 1.—An oxyfuel welding outfit.



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Leftward Welding: -Flat (Fig. 2)

This method is used on low carbon steel sheet and plate in thicknesses up to 5 mm and also on cast iron and certain non-ferrous metals. As the name implies, the weld is started at the right hand side and progresses towards the left. The filler rod precedes the blowpipe and is held at an angle of 30° - 40° to the work surface. The blowpipe is held at an angle of 60° - 70° to the work surface and is given a slight side to side movement to ensure side fusion as the filler rod is fed into the molten pool.

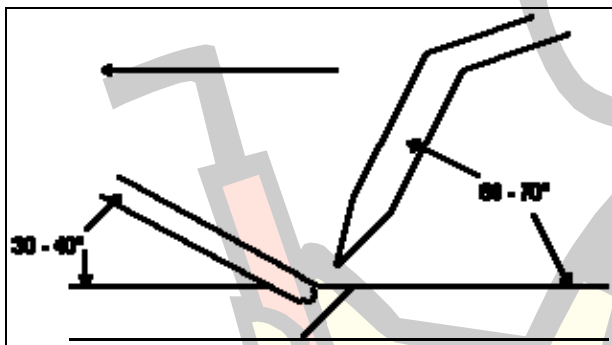


Fig. 2

Rightward Welding: -Flat (Fig. 3)

This method is used on steel plate over 5 mm thick. The weld is started at the left hand side of the joint and progresses towards the right. The blowpipe is held at an angle of 40° - 50° to the work surface and travels in a straight line. The filler rod, which is held at an angle of 30° - 40° to the work surface, follows the blowpipe and is fed into the molten pool with a circular action. A considerable amount of practice is required to perfect this technique.

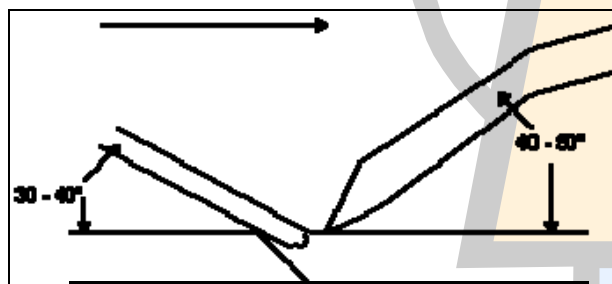


Fig. 3

The advantages of rightward welding over the leftward technique are higher speed, less distortion and more economical use of gas and filler rod. The reason being that thicknesses up to 8 mm need not be beveled, whereas for butt joints in plate over 8 mm, the included angle of the “v” preparation is only 60°.

All-Position Rightward Welding:

The all-positional rightward method is a modification of the rightward technique that is ideally suited for welding steel plate, and in particular, pipe work where positional welding (vertical and overhead) has to be carried out. The all-positional rightward technique enables the welder to obtain a uniform penetration bead with added control over the molten weld pool and weld metal. Moreover, the welder has a clear view of the weld pool and can work in complete freedom of movement. This technique requires someone who is highly skilled and will vary in its approach depending on the position the part is to be welded.

The Oxy-Acetylene Flame:

The heat source for this process is a chemical reaction resulting from the combustion of acetylene with oxygen. This is an exothermic reaction in which equal volumes of acetylene and oxygen supplied by the blowpipe react to produce carbon monoxide and hydrogen as products of the first stage of combustion. The reaction is as follows:

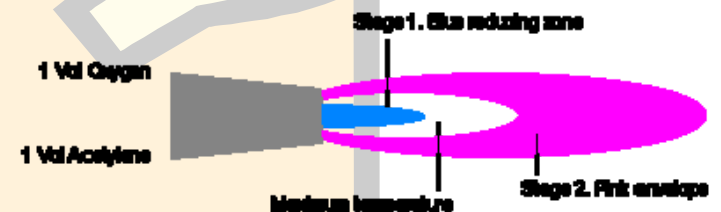


Fig. 3 The Oxy-Acetylene flame

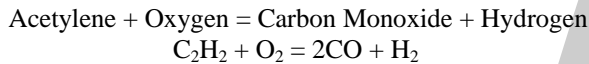
Theoretically, equal volumes of oxygen and acetylene are supplied to the blowpipe.

Chemical reactions are as follows:-

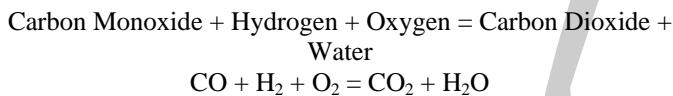


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Stage 1



Stage 2



In Stage 2, the carbon monoxide burns and forms carbon dioxide, while the hydrogen which is formed from the action in Stage 1, combines with oxygen to form water. The combustion is therefore complete with carbon dioxide and water (turned to steam) being its chief by products.

This produces a flame temperature of approximately 3200°C.

Types of Oxy-Acetylene Flame

Neutral Flame:

As the supply of oxygen to the blowpipe is further increased and the flame contracts, a white cone will become clearly defined, assuming a definite rounded shape. At this stage, acetylene and oxygen of similar equal quantities are being used and combustion is completed. All the carbon supplied by the acetylene is being consumed, producing maximum heat; the flame is now neutral. This type of flame is the one most extensively used by the welder, who should make himself thoroughly familiar with its appearance and characteristics.



Neutral flame

Carburizing Flame:

This is a flame in which an excess of acetylene is burning, i.e. combustion is incomplete and unconsumed carbon is present.

When lighting the blowpipe, acetylene is first ignited giving a very smoky yellow flame of abnormal size and has two cones of flame in addition to an outer envelope. This is an exaggerated form of the carburizing flame, but gives out comparatively little heat and is of little use for welding. When oxygen is turned on and the supply is gradually increased, the flame, though still of abnormal size, will contract towards the blowpipe tip where a bright inner white cone will begin to show. If the increase in the supply of oxygen is stopped before the cone becomes clearly defined and while it is still an inch or so long, the result is a carburizing flame. This type of flame is mainly used for hard surfacing and should not be employed for welding steel as unconsumed carbon may be introduced into the weld and produce a hard, brittle deposit.



Carburizing flame

Oxidizing Flame:

A further increase in the oxygen supply produces an oxidizing flame in which there is more oxygen than is required for complete combustion. The inner cone becomes shorter and sharper, with the flame turning a deeper purple color and emitting a characteristic slight "hiss". The molten metal will be less fluid and tranquil during welding and excessive sparging will occur. An oxidizing flame is only used for special applications, and should never be used for welding.



Oxidizing flame

In our next issue we will discuss AWS A5.3 "Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding"