METAL 101

AN ELEMENTARY LOOK AT DIFFERENT FACETS OF METAL

ARC WELDING BASICS

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At first glance, welding can seem very complex and dangerous. There's the welding mask and the other safety equipment that the operator is wearing. There's that big blinding light, the sparks, the heat. Looks like a dangerous game, but rather simple when broken down to its components.

Welding is one of several methods used to join metal. You apply intense heat to the metal joint and this causes some of the material to melt and intermix. You frequently use a molten intermediate filler metal to speed the process along. Then the intermixed metals cool and solidify to give you a completed joint, which in theory is as strong as the original metal. This is a method that is much stronger than other methods of fusing metal such as brazing or soldering.

The intense heat that melts the metal is applied by an electric arc. That's the bright light you see. It comes from a welding machine by way of two welding cables carrying current through a complete circuit. One cable is fastened to a ground clamp which in turn is attached to the work piece or welding table. The other cable is connected to an electrode holder which holds the electrode as you are welding. As the charged electrode comes in close proximity with the oppositely charged work the current creates an arc that leaps the gap from the tip of the electrode to the work. The arc is usually about 9,000 degrees Fahrenheit (5,000 degrees Celsius) at the tip. The electrode is normally a stick or a wire. Most often they are specially made of the filler metal that melts and assists the welding process.

When metal melts it tends to react with the environment – notably air which is a mixture of oxygen and nitrogen. Oxides and nitrides form when air comes into contact with molten metal and this in turn destroys the strength and durability of the welded joint. What is done then is to cover the area of the weld with a protective shield of gas, vapour or slag. This process, known as arc-shielding, usually prevents the molten metal from coming into contact with the air. In most cases, this shielding will improve the weld. This happens when a flux is used that contains deoxidizers.

Just like with static electricity, an electrical current jumps between the positive electrode and negative work piece. If the electrode is too far away from the work piece, there is either no arc happening or the arc does not create enough heat to make a sufficiently strong weld. Getting the electrode the right distance from the work piece is the whole trick, and science, of welding. In most instances the electrode will also be a consumable item, it will melt as you work. You will have to compensate for this along the way, especially if you use a rod, or stick, welding system. If you have a welder that uses a wire feed system then you will not have to compensate for the disappearance of the electrode.

There are various different types of welders on the market. Shielded metal-arc welders (SMAW) are sometimes referred to as stick welders because you use a welding rod as an electrode. The rod, which melts away as you work serves as the electrode, flux and filler metal combined. This is a simple method but requires a greater degree of skill.

Tungsten inert gas (TIG) and metal inert gas (MIG) welders are two general types of gas-shielded welding (GSW) processes. MIG welding uses a consumable wire electrode. The shielding gas is supplied by a separate inert gas that is pumped in through the handle. The advantage of this system is that it is easy to learn and there is very little clean up needed to do. With TIG welding the electrode is not consumed but is only used to create the arc. Where extra material is needed for the weld a separate filler rod is placed at the joint.

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