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The Art of Welding: Joining Metals to Build the World

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Opinion Article

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DESCRIPTION

By utilising intense heat to melt the components together and then allowing them to cool, which results in fusion, welding is a fabrication method that unites materials, typically metals or thermoplastics. Welding is separate from lower temperature processes that don't melt the base metal (parent metal), such brazing and soldering.

The base metal is normally melted first, followed by the addition of a filler material to create a pool of molten metal (the weld pool), which cools to form a joint that, depending on the weld design (butt, full penetration, fillet, etc.), may be stronger than the base metal. To create a weld, pressure can either be applied alone, in combination with heat, or both. In order to prevent contamination or oxidation of the filler metals or molten metals during welding, a shield is also necessary.

Welding can be done with a variety of energy sources, such as gas flames (chemical), electric arcs (electrical), lasers, electron beams, friction, and ultrasound. Welding can be done in a variety of settings, including the open air, underwater, and in space, despite the fact that it is frequently an industrial activity. Welding is a risky activity, thus safety measures must be taken to prevent burns, electric shocks, visual impairment, inhalation of toxic fumes, and exposure to strong ultraviolet radiation.

Blacksmiths had been joining iron and steel by heating and hammering for millennia, and until the end of the 19th century, there was only one method of welding available: forge welding. The first welding techniques to emerge were arc and oxy-fuel welding, which were followed quickly by electric resistance welding. The early 20th century saw rapid advancements in welding technology as the need for durable and affordable joining techniques increased due to the world wars. Following the wars, a number of contemporary welding techniques were created, including semi-automatic and automatic procedures like gas metal arc welding, submerged arc welding, flux-cored arc welding, and electroslag welding, as well as manual techniques like shielded metal arc welding, which is currently one of the most popular welding techniques. The invention sparked other developments.

Elihu Thomson received the first patents for resistance welding in 1885, and during the following 15 years, he made additional advancements. Resistance welding was also developed in the closing decades of the 19th century. In the same year that thermite welding was developed, oxyfuel welding also started to gain popularity. Edmund Davy discovered acetylene in 1836, but it wasn't feasible to utilise it for welding until about 1900, when a suitable torch was created. Due to its portability and affordable price, oxyfuel welding was initially one of the most well-liked welding techniques. But as the 20th century went on, it lost favour for use in industrial settings. Arc welding mostly took its place as metal coatings (also known as flux) developed.

Shielded Metal Arc Welding (SMAW), also known as Manual Metal Arc Welding (MMAW), or stick welding, is one of the most used arc welding techniques. The consumable electrode rod, which is formed of filler material (often steel) and is covered with a flux, is used to create an arc between the base material and the base material in order to protect the weld region from oxidation and contamination by releasing carbon dioxide (CO_2) gas during the welding process. Separate filler is not required because the electrode core itself serves as the filler material.

Although almost all weldable metals can be utilised with GTAW, stainless steel and light metals are where it is most frequently used. When producing high-quality welds is crucial, as as in bicycle, aviation, and naval applications, it is frequently utilised. Plasma arc welding is a comparable technique that likewise employs a tungsten electrode but creates the arc using plasma gas. The approach is often limited to a mechanized process since the arc is more concentrated than the GTAW arc, making transverse control more crucial. The approach is substantially faster than the GTAW procedure and can be utilised on a wider range of material thicknesses because to its steady current. Except for magnesium, it can be used on all of the same materials as GTAW and is automated.

A variety of different power supplies can be utilised to provide the electrical power required for arc welding processes. Constant voltage and constant current power sources are the two types of welding power supplies most frequently used. In arc welding, the voltage and current are closely correlated with the arc's length and heat input, respectively. For manual welding procedures like gas tungsten arc welding and shielded metal arc welding, constant current power supply are most frequently utilised since they keep the current reasonably constant even when the voltage changes. It might be challenging to hold the electrode precisely constant during manual welding, which causes the arc length and consequently the voltage to fluctuate.