Gas Metal Arc Welding

Transfer Modes

In gas metal arc welding, a continuous electrode is melted by an arc established between the electrode tip and the workpiece. The melted electrode transfers into the molten weld pool in a variety of ways depending on current, electrode diameter, arc length, power supply and shielding gas.

Short Circuiting Transfer

In this transfer, the end of the electrode actually touches the molten pool, creating a momentary short circuit. This condition triggers an increase in current sufficient to melt the tip of the electrode and then establish an arc between the electrode end and the workpiece. The cycle repeats itself about 50 to 250 times per second. This type of transfer is good for welding thin metals in all positions, but because of its low-current operation, incomplete fusion may occur in base metals in excess of 1/8 in. (3.2 mm).

Globular Transfer

This transfer occurs at a current range above short-circuiting transfer. The melted droplets that transfer into the molten pool are about two to four times the diameter of the electrode, and they fall in an irregular pattern and with an irregular frequency. This transfer produces spatter, and in most instances, it is the type of transfer when CO^2 is the only shielding gas.

Spray Transfer

This transfer occurs at high welding currents with argon-rich (90% +) shielding gas mixtures. The molten droplets are small, and they are forced across the arc in an axial pattern. The arc column is constricted. This type of transfer produces minimal spatter and is conducive to high deposition rates.

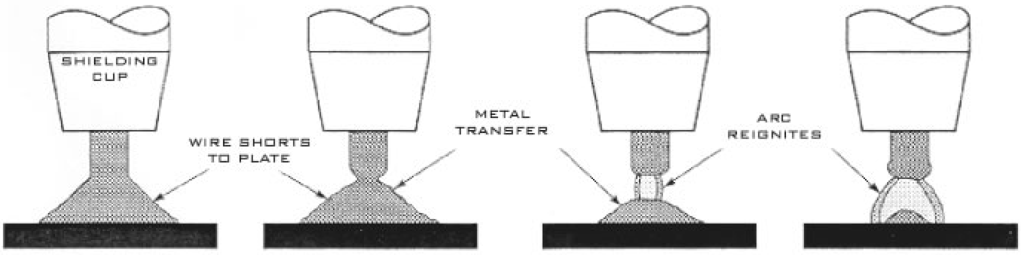
Pulsed Spray Transfer

A power supply specially designed for this process switches the current from a low background current to a high peak current in milliseconds. This switching or "pulsing" creates a very stable arc condition. The metal is transferred only at the high current, while the background current maintains the arc. The molten metal is transferred as fine droplets similar to the spray mode, producing very minimal spatter. Ideally, one droplet is transferred with each pulse.
This process offers the advantages of spray transfer, but the molten weld pool is not quite as fluid. This allows control of the weld pool when joining thick weldments.

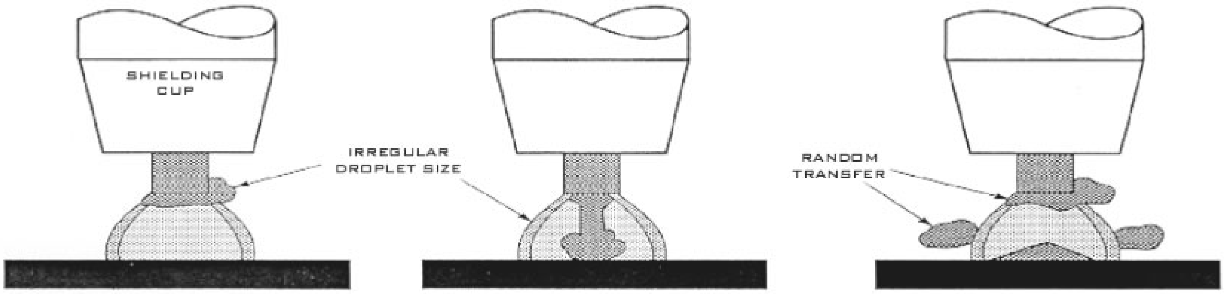
Rotational Spray Transfer

This transfer occurs when a solid wire is used with a long electrode extension of 7/8 to 1 1/2 in. (22-38 mm) and the shielding gas is a mixture of argon-carbon dioxide-oxygen or argon-oxygen. The long electrode creates resistance heating of the electrode that causes the end to become molten. Electromechanical forces make the molten end of the electrode rotate in a helical pattern. The shielding gas mixtures affect the surface tension of the molten end assisting the rotational transfer. Deposition rates of 18 to 30 lb/h are attainable with this transfer mode.

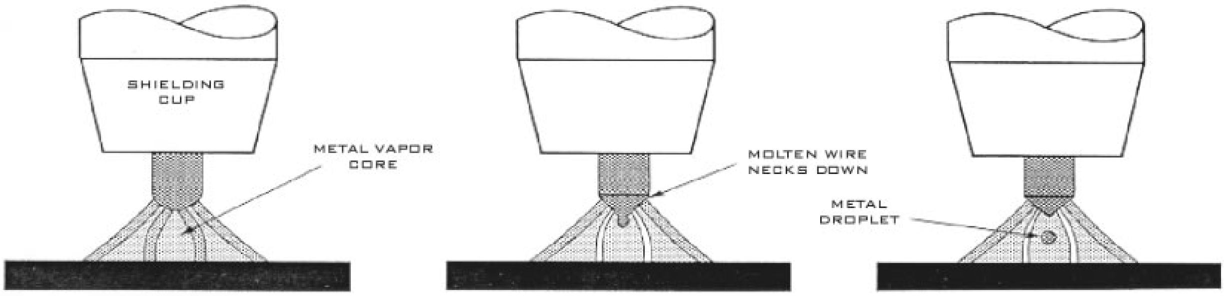
The rotational phenomenon will be inhibited by high thermal conductivity in the shielding gas and an increase in the surface tension at the tip of the molten electrode. This can occur when the gas mixture is high in carbon dioxide or helium is incorporated into the mix. This condition will increase the size of the droplets and decrease the transfer rate. The arc plasma becomes narrower than in the rotational mode, but the transfer is similar to an axial spray. Joint penetration increases when the arc becomes more concentrated.



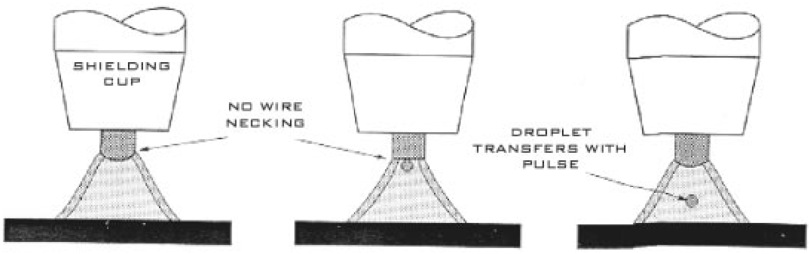
SHORT CIRCUITING TRANSFER



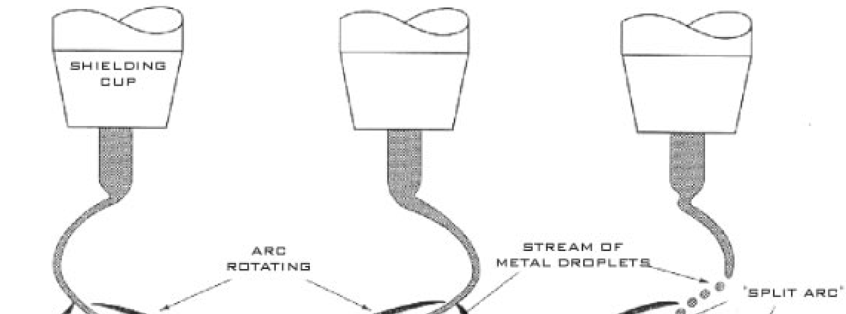
GLOBULAR TRANSFER



SPRAY TRANSFER



PULSED SPRAY TRANSFER



ROTATIONAL SPRAY TRANSFER