Shielded Metal Arc Welding (SMAW / “Stick”)

Shielded Metal Arc Welding (SMAW / â€œStickâ€)

The shielded metal arc welding (SMAW / “Stick”) process generates an arc between a flux-coated consumable electrode and the work-piece. SMAW is well known for its versatility because it can be used in all welding positions, and in both production and repair welding situations. It is one of the simplest welding processes in terms of equipment requirements and can be easily operated in remote locations. However, it is strictly a manual welding process that generally requires a high welder skill level. In addition, it is typically restricted to material thickness greater than approximately 0.062 in (1.6 mm).

HASTELLOY® and HAYNES® coated electrodes for SMAW undergo a number of qualification tests to determine the usability of the electrode, the chemical composition of the weld deposit, and the soundness and mechanical properties of the weld metal. Coated electrodes are generally formulated to produce a weld deposit with a chemical composition that corresponds to that of the matching base metal. The coating formulations are generally classified as slightly basic to slightly acidic depending on the particular alloy. For further information on the requirements for the classification of Ni-base coated electrodes, the reader is referred to: *AWS A5.11/A5.11M, Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding, American Welding Society*.

Prior to their use, coated electrodes should remain sealed in a moisture-proof canister. After the canister has been opened, all coated electrodes should be stored in an electrode storage oven. It is recommended that the electrode storage oven be maintained at 250 to 400ºF (121 to 204ºC). If coated electrodes are exposed to an uncontrolled atmosphere, they can be reconditioned by heating in a furnace at 600 to 700ºF (316 to 371ºC) for 2 to 3 hours.

Typical SMAW parameters are presented in Table 3 for flat position welding. While the coated electrodes are classified as AC/DC, in almost all situations electrical polarity should be direct current electrode positive (DCEP / “reverse polarity”). For maximum arc stability and control of the molten pool, it is important to maintain a short arc length. The electrode is generally directed back toward the molten pool (backhand welding) with about a 20° to 40° drag angle. Even though stringer bead welding techniques are generally preferred, some electrode manipulation and weaving may be required to place the molten weld metal where it is needed. The amount of weave is dependent on weld joint geometry, welding position, and type of coated electrode. A rule of thumb is that the maximum weave width should be about three times the electrode core wire diameter. Once deposited, weld beads should preferably exhibit a slightly convex surface contour. Appropriate welding current is based on the diameter of the coated electrode. When operated within the suggested current ranges, the electrodes should exhibit good arcing characteristics with minimum spatter. The use of excessive current can lead to overheating of the electrode, reduced arc stability, spalling of the electrode coating, and weld metal porosity. Excessive spatter is an indication that arc length is too long, welding current is too high, polarity is not reversed, or there has been absorption of moisture by the electrode coating. The suggested travel speed for SMAW is 3 to 6 inches per minute (ipm) / 75 to 150 mm/min.

Out-of-position welding is recommended only with 0.093 in (2.4 mm) and 0.125 in (3.2 mm) diameter electrodes. During out-of-position welding, the amperage should be reduced to the low end of the suggested range in Table 3. In order to keep the bead profile relatively flat during vertical welding, a weave bead technique is necessary. Using 0.093 in (2.4 mm) electrodes will reduce the weave width that is required and produce flatter beads. In vertical welding, a range of electrode positions is possible from forehand (up to 20° push angle) to backhand welding (up to 20° drag angle). In overhead welding, backhand welding (drag angle of 0°to 20°) is required.

Starting porosity may occur because the electrode requires a short time to begin generating a protective atmosphere. This is a particular problem with certain alloys, such as HASTELLOY® B-3® alloy. The problem can be minimized by using a starting tab of the same alloy as the work-piece or by grinding each start to sound weld metal. Small crater cracks may also occur at the weld stops. These can be minimized by using a slight back-stepping motion to fill the crater just prior to breaking the arc. It is recommended that all weld starts and stops be ground to sound weld metal.

The slag formed on the weld surface should be completely removed. This can be accomplished by first chipping with a welding/chipping hammer, then brushing the surface with a stainless steel wire brush. In multi-pass welds, it is essential that all slag is removed from the last deposited weld bead before the subsequent bead is deposited. Any remaining weld slag can compromise the corrosion resistance of the weldment.

Table 3: Typical Shielded Metal Arc Welding Parameters (Flat Position)

Electrode Diameter		Arc Voltage	Welding Current
in	**mm**	**Volts**	**Amps**
0.093	2.4	22-25	45-75
0.125	3.2	22-25	75-110
0.156	4.0	23-26	110-150
0.187	4.7	24-27	150-180