Description

Image



Image caption

(1) GYS - MMA Arc Welder © Bruno Bouygues at Wikimedia Commons (CC BY 3.0) (2) Stick welding pipe welding application © Mgschuler at Wikimedia Commons (CC BY 3.0) (3) An example of a manual metal arc weld. © Mig-welding

The process

MANUAL or SHIELDED METAL ARC WELDING (MMA or SMA), also known as TORCH WELDING, is the most important general purpose welding and surfacing method using low cost equipment. In it, an electric arc is established between a flux-coated consumable rod (an electrode) and the component. The flux coating decomposes to give a gas shield; the slag that forms over the weld-pool prevents the metal from oxidizing. Appropriate choice of metal and flux allow the process to be used for a wide variety of applications, though they are almost exclusively limited to ferrous alloys. MMA equipment is portable, and the process is very flexible but, being manual, requires high operator skill.

Process schematic

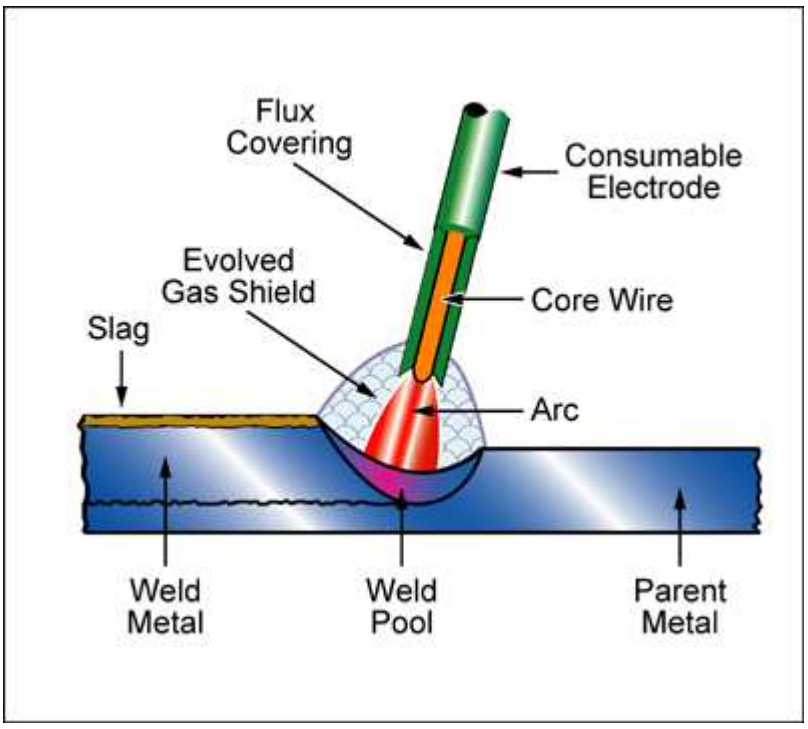

Figure caption

Manual metal arc or torch welding

Material compatibility

Metals - ferrous	✓

Function compatibility

Electrically conductive	✓
Thermally conductive	✓
Watertight/airtight	✓
Demountable	✗

Joint geometry compatibility

Lap	✓
Butt	✓
Sleeve	✓
Scarf	✓
Tee	✓

Load compatibility

Tension	✓
Compression	✓
Shear	✓
Bending	✓
Torsion	✓
Peeling	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	low
Labor intensity	high

Physical and quality attributes

Range of section thickness	1.5	-	300	mm
Unequal thicknesses	✓			
Processing temperature	1.5e3	-	1.7e3	℃

Process characteristics

Discrete	✓
Continuous	✓

Supporting information

Design guidelines

MMA is easy to use, and very flexible, making it a prime choice for one-off or low volume production; but - because it cannot be automated - it is not an appropriate mass production process. Distortion caused by thermal expansion is minimized by designing symmetry into the weld lines, and balancing the welds around the neutral axis of the structure. Weld lines are best designed to be straight or have simple contours, and the joint must be designed to allow access to the weld torch.

Technical notes

Carbon, low alloy and stainless steels, cast irons and certain nickel alloys can be joined by MMA welding. Dissimilar materials are difficult to weld. The weld rod is consumed, providing filler metal to the weld; but when it is used up it has to be replaced, disrupting the welding process and causing random stresses in the joints. The flux must be removed in a cleaning operation between each weld pass.

Typical uses

MMA is used to join pressure vessels, structural steel work, pipe work, to attach stiffeners to structures in ship building, and in general engineering.

The economics

MMA welding is a versatile, low cost process, easily transported, but it cannot be automated because of the limited length of each electrode.

The environment

Welding fumes can present health hazards, and radiation from the weld can damage eyesight. Good ventilation and the use of welding masks and tinted goggles overcome these problems.

Links

MaterialUniverse

Reference