Description

Image


Image caption

(1) GMAW application on Stainless Steel © Mgschuler at Wikimedia Commons (CC BY 3.0) (2) Flux cored arc welding © TWI Ltd at flickr (3) Plate some welding tests © Granta Design at TU Delft University

The process

Gas metal arc (MIG) welding is a heavy-duty welding processes (together with MMA and TIG). The electrode here is a bare wire, with no flux. The flux is replaced by a stream of inert gas, which surrounds the arc formed between the consumable wire electrode and the component; the wire is advanced from a coil as the electrode is consumed. The real advantages over torch welding are that there is no flux or slag, giving a cleaner weld - and that it can be automated. But there is a penalty: because the process needs gas, it is more expensive and less portable. None the less, MIG is considered to be the most versatile of all arc welding processes, allowing the welding of most ferrous and non-ferrous alloys in a wide range of thicknesses and all welding positions.

Process schematic

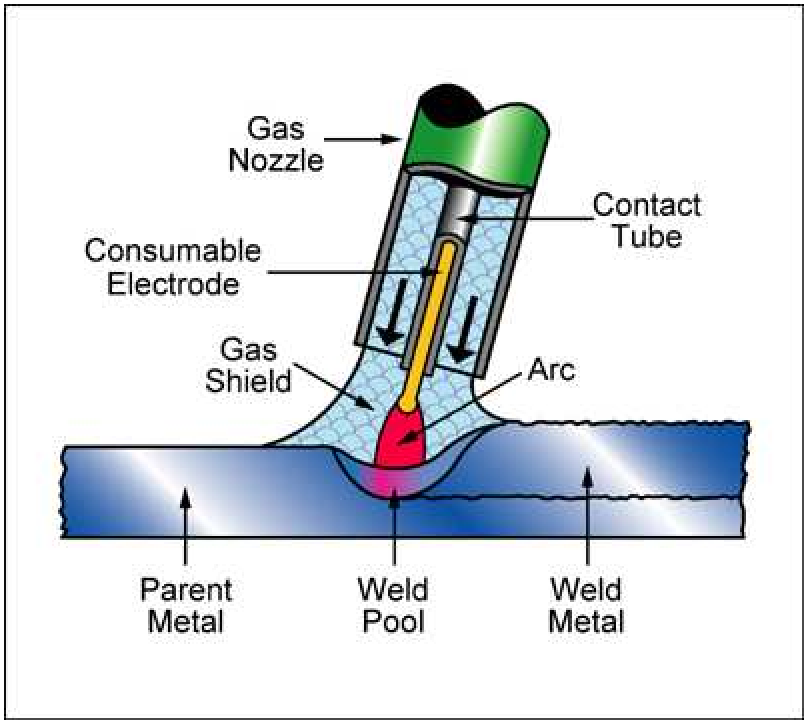

Figure caption

Gas - metal arc welding

Material compatibility

Metals - ferrous	✓
Metals - non-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	medium
Labor intensity	low

Physical and quality attributes

Range of section thickness	1	-	12	mm
Unequal thicknesses	✓			
Processing temperature	597	-	1.98e3	°C

Process characteristics

Discrete	✓
Continuous	✓

Supporting information

Design guidelines

If you want high quality welds in aluminum, magnesium, titanium, stainless steel or even mild steel, MIG welding is the process to choose. It is best for fillet welds though an adaptation - MIG spot welding - and lends itself well to lap joints. Distortion by thermal expansion is minimized by designing symmetry into the weld lines, and balancing the welds around the neutral access of the structure. Weld lines are best designed to be straight or have simple contours, and the joints are designed to allow access for the weld torch; it is important that the nozzle is close to the component so that the molten metal is well shielded by gas.

Technical notes

Most common metals and alloys except zinc can be welded using MIG; electrode wire (the filler material) is available for welding all of these. The shielding gas is usually argon, helium, carbon dioxide or a mixture of these - it is chosen to suit the material being welded. The process produces uniform weld beads that do not require de-slagging, making it suitable for mechanization and operation by welding robots. MIG can make most joint geometries and can be done in most orientations, but is most efficient when flat and horizontal.

Typical uses

MIG welding is used throughout the industry in both manual and automatic versions, particularly shipbuilding, structural engineering, process plant and electrical engineering, domestic equipment and the automobile industry. It is indispensable for welding difficult, non-ferrous metals such as aluminum, magnesium and titanium.

The economics

Equipment costs are moderate, tooling costs are low. MIG welding is more expensive than torch welding because of the cost of the inert gas, but it is rapid and requires less labor.

The environment

Health hazards depend on the composition of the electrode and component; both appear as airborne fume during welding. Radiation from the weld can be harmful to the eye, requiring that a welding helmet and tinted safety goggles must be worn.

Links

MaterialUniverse

Reference