Welding of Aluminium

Aluminium is successfully welded only after careful thought and preparation. Through correct preparation, it is easier to avoid the pitfalls that can trap the unwary. Therefore, this introduction includes facts on base metals, welding methods, types of joint and filler metals. This introduction is just a general guideline. Please contact us for more information.

Base metals

Aluminium and its alloys can be divided into three major groups:

- Aluminium
- Non-hardenable / non-heat treatable alloys
- Hardenable / heat treatable alloys

Aluminium is developed in various grades of purity. The most common commercial grades contain 99.7-99.5% or 99,0% aluminium. Non-hardenable alloys, i.e. not suitable for heat treatment, contain small amounts of Mn or Mg. AlMn alloys are often made up of between 1.0-1.2%Mn, while AlMg alloys with up to 5% are quite common. AlMgMn alloys are also used. The hardenable alloys contain copper (Cu), magnesium and silicon (Mg+Si), or zinc and magnesium (Zn+Mg).
Aluminium and most of the non-heat treatable and heat treatable alloys possess good weldability. In the case of hardenable alloys with copper and lead additives, there is a risk of hot cracking and therefore they are difficult to weld. Many casting alloys are also suitable for welding except in the case of those, which have a high content of copper or magnesium which cannot be welded.

Welding methods

Aluminium can be welded easily. Consideration must be given to both the welding method, the type of joint and the filler metal. The two dominating welding processes are GMAW (MIG) and GTAW (TIG) welding, but also gas, plasma and resistance welding are used, as well as welding with stick electrodes (SMAW).
Determining the welding process depends on numerous factors. TIG welding is better for thin light-gauge materials, when there is a need for good surface finish and for single sided welding (such as when welding pipes) as well as repair welding. TIG welding is generally done on AC current.
MIG welding is used primarily in the case of thicker or heavy-gauge materials and when high speed is a priority in combination with long continuous welds. Due to the lower heat input, MIG welding results in less distortion in the welding zone. Pulse-arc welding with MIG is an interesting technology.
Stick electrodes are used mainly for repair jobs. The advantage of this process is the simple controllability, as well as the possibility to be flexible in any environment. Low investment costs can be a factor for choosing SMAW.

Types of joint

The type of joint depends on the thickness of the base materials and the type and shape of the workpiece. As a rule no preparation is required for thinner materials. An ordinary I-joint is recommended for single-sided TIG welding plates ≤ 4mm. plate thickness, a 50º V-joint with a 2 to 3 mm. bevelled edge is recommended for double-sided welding plates > 4 mm. thickness. Alternatively, a 90º double V-joint can be applied.
Good joint preparation makes welding easier, saves shielding gas and filler metals, and contributes to the quality of the weld.
A special characteristic of aluminium is the higher melting point of oxide that forms on its surface. To avoid welding defects the joint surface must be scraped or brushed using stainless steel wire brushes.
Bear in mind that welding causes greater deformation in aluminium than it does in steel. It is therefore essential to give careful consideration to all aspects of the welding process.

Filler metals

The choice of which filler metal to use, is based on the composition of the base materials and the requirements of the finished product. Generally speaking, aluminium and non-heat treatable alloys should be welded with matching filler metals. Alloys, which are suitable for hardening, should be welded with a filler metal with a high content of Si or Mg in order to avoid the risk of hot cracking.
If there is a need for a good match in colour between the welded joint and the base materials after anodic treatment, a suitable filler metal should be used.
As in the case of base materials, care must be taken to keep the filler metals clean and free from any contamination (especially oil, grease or dust). Keep your filler metals in warm and dry conditions. In storing stick electrodes take extra precautions and store the electrodes in their original hermetically sealed aluminium cans.