The Sheet Metal Welding Process: What You Need to Know

The Sheet Metal Welding Process

The sheet metal welding process ensures we employ the right method to fit your precise needs, saving both cost and time. As with all sheet metal work, early planning and decision-making will ensure the welding stage of your project is a successful one. That's what this blog is all about.

What is sheet metal welding?

Welding is a process whereby two or more parts are fused together by means of heat, pressure or both. Then, as the parts cool, they form a join. Welding is usually associated with metals and thermoplastics but can even be used on wood.

The parts that are joined are known as the 'parent' material. The material added to help form the join is called a 'filler' such as plate, pipe, filler wire or electrode. These fillers are often similar in composition to the parent material. They form a homogenous weld. However, there are occasions, such as with brittle cast irons, when a different filler is required. These welds are called heterogeneous.

The major welding methods

The choice of welding methods depends on both the materials involved and the circumstances in which they are being used:

The TIG method

Also known as Gas Tungsten Arc Welding (GTAW), TIG welding involves heat building up from an arc created by electricity in the tungsten electrode, the actual filler. The weld pool or 'puddle' (which joins the two pieces) is protected from any contaminants by a gas shield.

This is what we call ‘cosmetic’ welding for interior structures where the look is important, such as for a stainless steel hand rail. The wire is fed in slowly (7” – 15” per minute) so the welding is more controlled and, therefore, neater. Then, all that’s required is a clean, grind and polish.

The MIG method

MIG welding (or Gas Metal Arc Welding – GMAW) uses a continuous solid wire electrode which is automatically fed through a welding gun. The contact tip is electrically charged, creating enough heat to melt the wire and create the weld puddle. Again, a gas shield protects the pool from defects caused by any contaminants.

MIG is used for heavy duty fabrication welding, where a thicker weld bead provides the necessary strength structually and is visually appropriate. For example, a metal gate or heavy duty balustrade.

Laser welding

Laser welding is a fast and accurate process, more commonly used for mass production (eg 500+) of parts. Otherwise, TIG or MIG are more cost effective options.

Laser welding provides robot-like consistency with speeds ranging from 50” to 80” per minute. The laser beam provides the concentrated heat source to melt the materials together. However, the gap between the parts cannot exceed .005”. There are two laser weld types: cosmetic (or conduction) and keyhole. For the cosmetic weld, the laser is ‘defocused’ to allow for a very smooth, wide weld. With keyhole weld (for thicker steel) the laser burns through the first layer of the material into the second. As the molten material cools, it creates a solid weld joint.

In addition to speed, laser welding benefits include thin, small weld seams and low thermal distortion. Unlike TIG or MIG welding, no filler wire is required, so there is very little build-up of weld material. This also means that much smaller parts can be welded.

Types of metals you can weld

As we mentioned earlier, welding is appropriate for many different materials. The most common in sheet metal fabrication are mild steel, stainless steel, aluminium & copper.

Carbon steels (coated and uncoated)

MIG welding is preferred over TIG welding for carbon steel because of speed. However, MIG is the better choice where joining parts don't fit together closely, such as an outside corner weld.
Both cosmetic and keyhole laser welding is ideal for carbon steel using both short and long wavelength machines. The build-up of material is minimal in laser welding. This is so steel parts can go straight to the paint line and minimal cleaning is required post-weld.

Coated steels (galvanized, galvannealed), however, present a challenge to laser welding, particularly keyhole. The different melting points of the coating and substrate material result in an incomplete weld. As the coating turns to gas, 'spatter' is generated which disturbs the weld puddle.

Stainless steel sheet metal

Pulse MIG welding is used for stainless steel to reduce spatter. With pulse MIG welding, there is no contact between the electrode and the pool. The electrical current pulses high to low, producing drops of molten metal from the electrode.

Naturally, where a clean 'cosmetic' appearance is important, TIG is the preferred choice for welding stainless steel. Both heat input and speed need to be controlled. This is because this metal is susceptible to warpage (the 'heat-affected' zone) from uneven heating. With TIG, there is rarely any need for post-weld clean-up. This is unless there's a particular texture to be matched, such as brushing.

Laser welding is fine for stainless steel, whether cosmetic or keyhole. Cosmetically, the great benefit lies in the laser weld speed reducing the heat-affected zone substantially. Depending on the intended use of the product, a post-weld process to remove heat tint may be necessary. However, re-graining and blending isn't a requirement thanks to the small weld seams.

Aluminium sheet metal

We use a pulse MIG machine on aluminium together with 'special assist' gas. As spatter and dust are concerns on aluminium, a pre-weld clean to remove surface scale, is recommended. For laser welding aluminium (cosmetic or keyhole), you need a short wavelength machine so more of the beam is directed at the welding area. Many machines now have beam profile adjustments that allow the laser to produce a consistent, clean weld closely resembling a TIG weld.

Copper and iron

Welding either copper or iron is a bit more problematic due to the choice of different grades for both metals. Laser welding of copper is successful through varying both power and speed. Both TIG and MIG welding processes are commonly used for welding copper and its alloys. This because high localised heat input is important for materials with high thermal conductivity.

The different grades of cast iron include grey iron, white iron, ductile (nodular) iron and malleable iron with widely differing welding outcomes. The carbon content in cast iron is about ten times that of most steels. The welding process causes the carbon to migrate into the weld metal or the heat-affected zone. This leads to significant brittleness and hardness. This, in turn, can lead to post weld cracking.

Tips for welding sheet metals

We have two very important tips to help you ensure the best welding outcomes:

1. **The right welding process and filler metal:** Choose the right welding process and filler metal according to the type of material you are using and its intended use. If it's destined for interior, is the finish important? Alternatively, are you working on a robust external steel structure where look isn't important?
2. **Good fit-up and joint design:** 'Fit-up' is defined as a measure of the closeness, or degree of contact, between mating parts. Welding thin metal demands tight fit-up. You need to avoid creating a hole that encourages burn-through and a gap that can't absorb the heat.

Alroys welding skills and experience

Welding is regarded as a 'moderately to very difficult skill to accomplish'. The techniques, once learnt, take many years of practice to perfect. At Alroys, we have both the welding skills and the experience to make sure the sheet metal welding process benefits of all our customers.