



The Most Common MIG Weld Defects on Aluminium and Steel and How to Avoid Them

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Some of the most common weld defects are porosity, lack of fusion and burn through, with aluminium presenting a few more welding challenges than steel. Aluminium conducts heat about six times faster than steel, plus it has excellent thermal conductivity coupled with a low melting point, making it extremely susceptible to warping and burn-through. Additionally, aluminium wire has less tensile strength, which can pose wire feeding issues and lead to weld defects if the correct equipment is not used. We'll highlight the differences here.

Porosity:

Shielding gas protects the molten weld pool from the surrounding atmosphere, which would otherwise contaminate the weld. Figure 1 shows how the lack of shielding gas on steel can cause porosity (pinholes) in the weld bead are formed in the face and weld interior in the absence of shielding gas. Lack of shielding gas can be caused by improper setting on the equipment, a hole in the gun liner or wind blowing the shielding gas away.



FIG. 1. No Shielding Gas on Steel - A lack of or inadequate shielding gas is easily identified by the porosity and (pinholes) in the face and interior of the weld.



FIG. 2

On aluminium, a sooty looking weld (FIG.2) can be caused by using a drag vs. a push technique (FIG. 3, below). The soot can be removed, but cutting the weld open will reveal pinholes where impurities are trapped in the weld. Aluminium builds up an oxide that needs to be removed before welding. Wire brushing is the most common method of cleaning aluminium, but it needs to be done with a stainless steel brush to avoid contaminating the weld with the impurities of a steel brush.

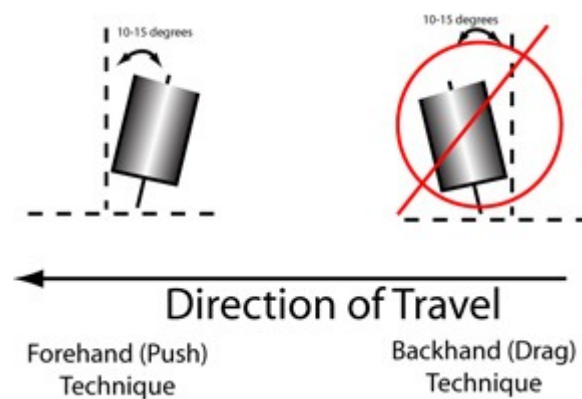


FIG. 3

Push vs. drag technique. On steel, either pushing or dragging the gun is acceptable, but with aluminium, the drag technique will lead to weld defects.

Lack of Fusion

Lack of fusion can occur when the voltage or wire feed speed is set too low, or when the operator's travel speed is too fast. Because aluminum conducts heat much faster than steel, it is prone to lack of fusion at the start of a weld until enough energy is put into the weld. Some welding equipment addresses this by automatically ramping up the current at the start of a weld and then decreasing it to avoid too much heat build up.

Craters

With aluminium, craters can form at the end of a weld. If they are not filled in, they create a stress point, which can lead to cracking. This requires the user to quickly trigger the gun again to fill in the crater, although some welding machines offer a crater timer that will fill in the crater when the gun trigger is released.

Burn Through

Too much heat input can be caused by setting voltage or wire feed speed too high or by too slow of a travel speed. This can lead to warping or burn through especially on the thinner materials found in the sign industry, aluminium being more prone to the effects than steel. Generally aluminium requires a faster travel speed than steel to avoid heat build up.

Feeding aluminium

Because of its low columnar strength, feeding aluminium wire has been likened to pushing a wet noodle through a straw. "Bird nesting" or the tangling of the wire between the drive roll and the liner is a common, time-consuming and costly problem. Clearing it requires the operator to stop welding, cut the wire, discard the wire in the gun, and re-feed new wire through the liner. It also may require cleaning or changing the contact tip because of the burn back caused when the wire stops feeding. There are several ways to feed aluminium wire: Push only, spool gun, push-pull system and continuous feed push only system.

Push only: Feeding aluminium wire through a push only system can be difficult, but it can be done on a limited basis. It requires u-groove drive rolls to provide more surface contact with the wire, a Teflon liner, adequate drive-roll pressure, the ability to keep the gun cable straight and a high tolerance for pain.

Spool Gun: A spool gun, such as the Spoolmatic® 15A or 30A, eliminates the possibility of bird nesting by putting a 4-inch (1-lb.) spool on the gun, so the wire only feeds a few inches. Spool guns can accommodate aluminium wire diameters from .023 to 1/16-inch and allow the operator to use longer cables (15'-50').

A spool gun needs to have the roll changed after every pound of wire is used, compared with the 8- or 15 lb spool on a push-pull system.

Push-pull gun: With a push-pull gun, a motor in the gun pulls the wire through the liner, while the motor in the welder or feeder control becomes an assist motor. By maintaining consistent tension on the wire, the push-pull system helps eliminate bird nesting. It is more ergonomic than the spool gun, since the weight of the spool is not in the operator's hands.

Also, the spool needs to be changed less often than on a spool gun and allows the purchase of larger spools. However, remember that aluminium builds up an oxide layer after being exposed to air for a while. If you only go through a pound or two of aluminium a week, the smaller spool may be a better choice.

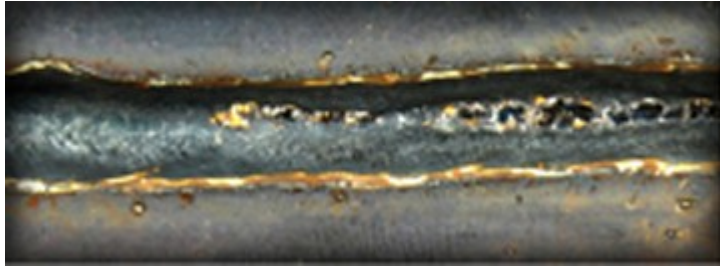
Troubleshooting



The photo above shows an example of a good weld on steel. Below are photos of a selection of bad welds that can result from a variety of potential problems, including the following:



Voltage Too Low - Too little voltage results in poor arc starts, control and penetration. It also causes excessive spatter, a convex bead profile, and poor tie-in at the toes of the weld.



Wire Feed Speed/Amperage Too High - Setting the wire feed speed or amperage too high (depending on what type of machine you're using) can cause poor arc starts and lead to an excessively wide weld bead, burn-through and distortion.



Wire Feed Speed/Amperage Too Low - A narrow, oftentimes convex bead with poor tie-in at the toes of the weld marks insufficient amperage.



Travel Speed Too Fast - A narrow convex bead with inadequate tie-in at the toes of the weld, insufficient penetration and an inconsistent weld bead are caused by travelling too fast.



Travel Speed Too Slow - Travelling too slowly may produce a large weld with excessive heat input resulting in heat distortion and possible burn through. In most cases, proper travel speed is when the arc is on the leading edge of the puddle.



Voltage Too High: Too much voltage is marked by poor arc control, inconsistent penetration, and a turbulent weld pool that fails to consistently penetrate the base material.