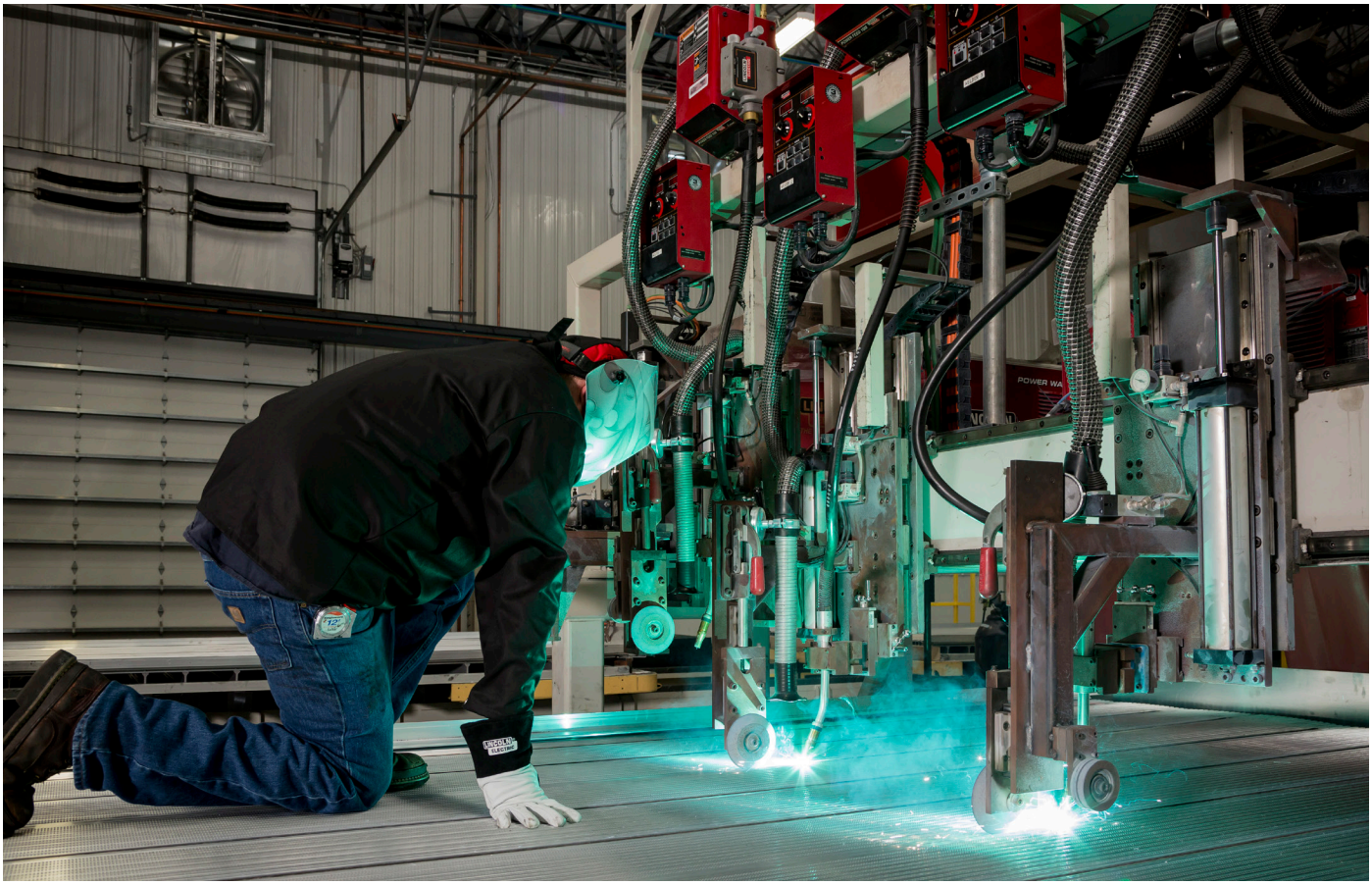
Best Practices to Weld Aluminum in the Trailer Industry



By Frank G. Armao,
Director, Aluminum Welding Technology

More and more welded assemblies are being made from aluminum alloys. While the alloy has a number of interesting characteristics, its light weight is largely responsible for an increase in use in the transportation industry.

Many experienced welding professionals mistakenly believe aluminum is a more difficult alloy to weld than steel. The perception is largely due to operators bringing their habits and experiences of welding steel to this material.

This article will examine common mistakes made when welding aluminum in the fabrication of trailers and how these mistakes can be corrected or avoided.

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THE LINCOLN ELECTRIC COMPANY
22801 Saint Clair Avenue · Cleveland, OH · 44117 · U.S.A.
Phone: +1 216.481.8100 · www.lincolnelectric.com

Know Your Alloy

Virtually all of the alloys in the 1XXX, 3XXX, 4XXX, 5XXX and 6XXX families are arc weldable using either the GTAW or GMAW process.

Most aluminum alloys in the 2XXX and 7XXX families are not weldable. The only weldable alloys in the 2XXX family are 2219 and 2519; in the 7XXX family, the only weldable alloys are 7003, 7004, 7005 and 7039.

Be particularly careful about 2024 and 7075. They are strong and commonly available, but unweldable.

Welding an "unweldable" alloy or using the wrong filler alloy can result in immediate cracking or a premature failure in service at a later time.

Prior to welding, the correct alloy should always be identified and matched to the correct filler metal.

Using the Correct Filler Alloy

The most common applications in the trailer industry are joining one of the 5XXX Al-Mg sheet/plate alloys – such as 5052, 5154 , 5454 or 5083 – to themselves or in the joining of a 6XXX extrusion alloy to one of the above mentioned 5XXX alloys.

For joining the 5XXX alloys to themselves, the correct filler alloy is 5554 for welding 5154 or 5454; for welding 5052, either 4043, 5554 or 5356 should be used, although 5356 and 5554 are more commonly used so that one filler alloy can be used in the shop to avoid the possibility of mixing up filler alloys. For welding 5083, which has higher strength, 5556 or 5183 are recommended. 5356 does not quite match the strength of 5083. 4043 should not be used to weld 5XXX alloys, except for 5052, which has a low Magnesium content.

For joining a 5XXX sheet or plate to a 6XXX extrusion alloy, such as 6061-T6, the recommended filler alloys are 5356 or 5554. While 4043 can also be used, it is not common in the trailer industry because of its limited application and that it can create confusion in the shop. There is absolutely no advantage in using the higher strength fillers 5183 or 5556 in this application. Some suppliers will try to sell these alloys, but they give no benefit despite their higher cost.

Correctly Storing Welding Filler Wire

Store aluminum filler wire in a clean and dry environment, preferably in its original packaging. Under such conditions, the wire has a usable shelf life of several years.

The filler wire must not be allowed to become wet and should be stored in conditions of low relative humidity. The easiest way to do this is to store the wire in its original packaging in a closed metal cabinet with an illuminated 60-watt light bulb. The bulb's heat will raise the temperature inside the cabinet by approximately 10 degrees F, which will lower the relative humidity.

Rolls of wire that have been partially used should be returned to their original packaging and not left uncovered on the welding machine overnight. Alternatively, keeping a spool of wire in a plastic cover until it has been completely used is acceptable.

Storing wire in an air-conditioned environment can cause problems. If the wire, which is relatively cold, is opened immediately on a hot, humid day, it is possible that the humid air will condense on the wire.

If the wire has to be stored in an air-conditioned room, bring it out into the shop unopened and let it sit until it has warmed up.

Preheating

Despite the widespread perception, all aluminum welds, both GTAW and GMAW, do not have to be preheated. In fact, preheat is rarely necessary with the correct equipment. What's more, excessive preheat can severely degrade the mechanical properties.

The last step in the heat treatment – aging – is conducted at temperatures between 325 and 400 degrees F. If you preheat treatable alloys to or above the aging temperature, you will ruin the alloy's mechanical properties.

This isn't to say that all preheating is bad. For example, it is acceptable to preheat to 200 degrees F to drive off moisture if the humidity is very high.

Clean the Parts Adequately

Cleaning aluminum before welding consists of two separate and distinct operations.

- All oils, lubricants, machining coolants or other hydrocarbons used in manufacturing must be removed. These hydrocarbons, if not removed, will get into the welding arc and release hydrogen gas, which causes weld porosity. Removing hydrocarbons can be done in one of two ways. The most common is to wipe the weld with a clean rag saturated with a good degreasing solvent, such as acetone , toluene, MEK or carburetion cleaner. Alcohols are not good degreasers and should not be used to clean aluminum. Alternatively, but less common, dip the aluminum into a tank containing a mild alkaline solution, then rinse and dry.
- Any heavy oxides must be removed. This is normally done by hand or power wire brushing with a stainless steel wire brush. In cases where materials have been stored outside and have developed a heavy gray oxide, it may be necessary to remove the oxide using a sanding or grinding disk.

The Correct Equipment

Welders should go over their welding equipment to make sure it is set for aluminum prior to each use. This is especially necessary if the equipment is used to weld different materials. Specifically:

- Make sure the spool brake is not set too tightly. Excessive tension will cause wire feeding problems. The brake should just be tight enough so it doesn't freewheel when the wire is stopped.
- Make sure the drive rolls are correct, both for aluminum and the diameter. Using V groove drive rolls, which are made to weld steel, on aluminum will deform the wire and cause feeding difficulties.
- Set the tension only tight enough so the drive rolls don't slip on the wire. Excessive tension will cause the filler wire to deform.
- Make sure the correct plastic inlet and outlet guide bushings are in place. Using parts intended to feed steel wire will cause feeding problems.
- Make sure the gun liner is the correct plastic material for aluminum. The use of the helical steel gun liner, typically used to feed steel wire, will take small shavings off the soft aluminum wire and cause the liner to clog up.
- Make sure the contact tip is the proper size for the aluminum wire. Some people believe it is a good idea to use an oversized contact tip – a 1/16-inch contact tip, for example, to feed 3/64-inch wire. DO NOT DO THIS. The tip must be of a size both to freely pass the wire through but still tight enough to provide uniform electrical contact between the contact tip and wire. An oversized contact tip will not allow uniform current transfer, resulting in an excessive number of burnbacks.

The Correct Shielding Gas Flow Rate

Argon shielding gas flow rates should be a minimum of 35 SCFH for GMAW and 25 SCFH for GTAW. If a large diameter gas cup or gas nozzle is used, the flow rates should be increased from these values.

Once Cleaned, Keep it Cleaned

Once the individual pieces have been cleaned and fit up, weld immediately, or at least as quickly as possible. Dirt, oil, water vapor, etc. in the shop environment can settle on the prepped material and contaminate the weld.

Do not let the part sit unprotected overnight or over the weekend once it is cleaned, fit and assembled. If the part must remain unwelded for any period of time, put brown craft paper over the weld seam and tape it in place.

Weaving and In-Line Oscillation

It is very common in the trailer industry for welders to use an inline weave or “shuffle,” though everyone agrees that side-to-side weaving across the seam produces excessive heat input and should not be used. This technique is fine as long as the amplitude of the shuffle is not too great.

The purpose of the shuffle is to produce the stacked dime appearance on the weld. The main advantage of this technique is that it produces obvious regularly spaced weld ripples similar to a GTAW weld. This seems to be almost a requirement in the trailer industry.

Shuffling is fine as long as the amplitude of the shuffle is controlled. It should be about 1/8 inch to 3/16 inch (3 mm to 4mm). If the amplitude of the shuffle is greater, it can produce low spots between each weld ripple. This can reduce the weld throat, which is not acceptable.

The shuffle is merely cosmetic; it does not produce improved penetration or cleaning.