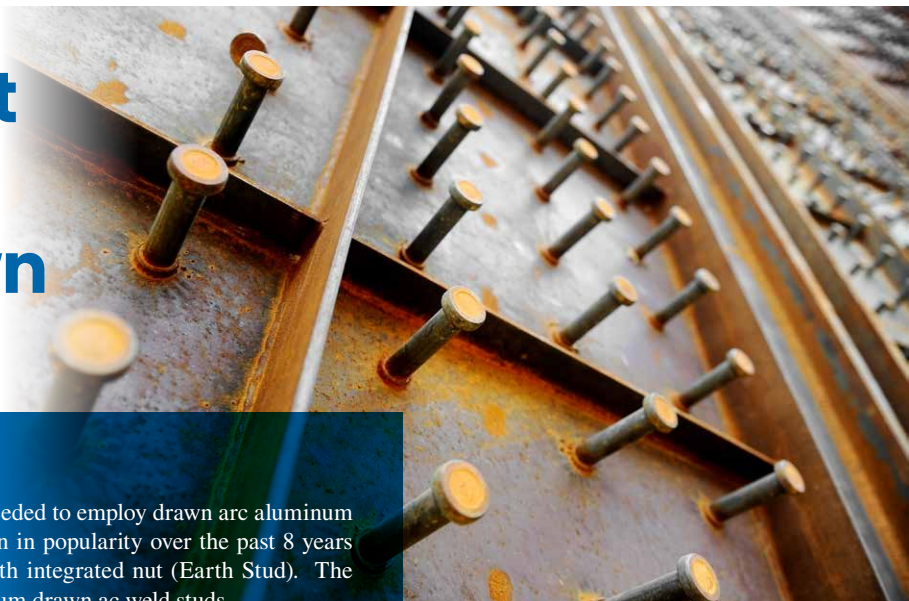


Points of Interest When Using Aluminum Drawn Arc Weld Studs



Prelude:

The information provided has some basic guidelines needed to employ drawn arc aluminum stud welding. The use of aluminum weld studs has grown in popularity over the past 8 years because of their light weight and electrical grounding with integrated nut (Earth Stud). The goal is to touch on important questions about using aluminum drawn arc weld studs.

What are a few special concerns with welding aluminum material?

Aluminum forms an oxidic skin when exposed to the environment. Aluminum oxide can also form during welding and is not advantageous. Also, there is concern about hydrogen dissolubility. When in the molten state, aluminum can react with hydrogen and create gas pockets in the solidified weld, making a porous material. The material must be free from moisture and lubricants. During welding the arc and molten material must be shielded by an inert gas, generally Argon.

What are the basic aluminum materials to attach a drawn arc stud onto?

Assuming a suitable surface is available, aluminum studs can be welded properly to components made of aluminum sheet stock, extrusions, and castings. Successful weld results in sheet stock 3xxx series (Al-Mn), 5xxx series (Al-Mg) (considered excellent weldability) & 6xxx series (Al-Mg-Si), castings 3xxx and 5xxx series, and extruded 6xxx series. Still, each application should be evaluated for weldability using proper welding equipment.

Are there dimensional and application limitations?

The minimum possible wall thickness of aluminum components to be stud welded is 1.0 mm without cracks appearing on the component back side. Recommendations are indicated in **Table 1** that may differ depending on the joining variables. Therefore, the greater the weld flange diameter (see **Graphic 1**) of a stud, the larger the material thickness of a component must be to successfully weld aluminum studs.

What is meant by backing the weld area?

Backing is defined as a solid non-ferrous material (Copper) block approximately the diameter of the gas shield touching the material and centered directly behind the weld zone. Usually, the backing block is spring mounted providing 178N to 222N of force (40 to 50 pounds).

What are the key aluminum panel surfaces conditions?

The material surface has a direct impact on the welding result. It is best to clean the components and subject them to a pickling passivation procedure to obtain a dry and contaminant free surface with a thin and even oxidic skin. Drawn arc welding uses AC welding machines which tolerate a small amount of dry lubricant. There are limits for maximum quantity and type of dry-film lubricants suitable for aluminum stud welding. Also, any additional lubrication with oil will have an adverse impact on the welding quality. These dry-film lubricants and oil must be studied, verified, and held constant if suitability testing shows it is feasible.

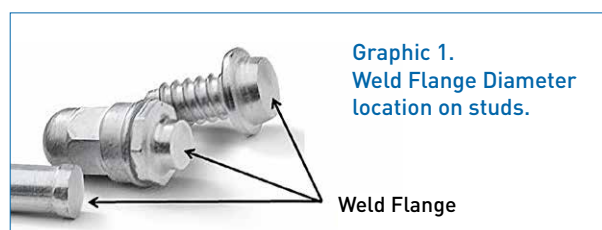


Table 1. Weld Flange Diameter vs. Weld Condition

		Weld Flange Dia. (mm)					
		4.2	7.5	8	9	10	11
Weld without Backing	Min. Panel Thickness, Cleaned & Passivated (mm)	1	1.1	1.2	1.4	1.7	2
	Min. Panel Thickness with Some Dry Lube (mm)	1.2	1.2	1.3	1.6	2	2.5
Weld with Backing	Min. Panel Thickness, Cleaned & Passivated (mm)	1	1	1.1	1.2	1.5	1.7
	Min. Panel Thickness with Some Dry Lube (mm)	1.1	1.1	1.2	1.4	1.7	2



Can moisture on the aluminum sheet panels be a concern?

Yes, condensation on panels will affect welding quality. Example, cold panels just delivered during the cold winter months should have time to warm up.

What are some of the key process limitations and conditions?

Resistance Spot Welding cannot be in the same station as drawn arc. Studs cannot be placed over joints with adhesive. Avoid inconsistent or excessive stamping draw lubricants. The best orientation is downward (see **Graphic 2**). The limit is 45 degrees. Gravity may impact distribution of fillet under certain conditions, larger studs and thick materials requiring longer weld times (see **Graphic 3**).



Graphic 2.
The best orientation to weld studs shows gas cover and secondary shield boot.



Graphic 3.
Hot aluminum fillet can drip during welding process due to gravity, shown at 90 degrees.

Is there particular material handling of Aluminum drawn arc weld studs?

Incoming aluminum weld studs are packaged in plastic bags. The studs have a one-year shelf life because old studs have aged thus changing their physical properties and require a modified weld schedule to be used. If stud bags are opened, the shelf life is compromised.

What is the proper storage of aluminum studs?

Aluminum studs must not be stored outside. Ideal storage is dry, low-heated rooms with low air humidity. Cold studs should be allowed to warm up to avoid condensation from air humidity. At least once every 6 months, all studs retained in the feeding drum or hopper should be removed and disposed of before refilling.

What are some of the stud and nut materials and preparations?

Many studs are made of AlMg5 (EN AW-5019, designated EN AW-Al Mg5) and the nuts are AlMg2,5 (EN AW-5052, designated EN AW-Al Mg2,5) or equivalent. Next, they undergo a surface treatment characterized by a series of pickling and cleaning, with a final passivation coating/finish process. The studs are then placed into sealed bags for transportation and storage. These bags should not be opened until the time of use.

Are there specific stud and nut surface finishes?

Common surface finishes for studs are BONDERITE M-NT 2040 (a.k.a. Henkel Alodine 2040), or equivalent, which provides a consistent known oxide layer and a shelf life of about 1 year. The nuts have a dry lubricant Microgleit DF921, or equivalent, to provide a constant low friction for torque performance and reduce the potential for mating thread galling.

Are there reprocessing solutions for improper welds?

If the stud breaks off or welding is not possible and the wall thickness is < 1.5 mm, then a break-stem rivet with threaded mandrel could be used. These rivets are made of steel and require special sealing and corrosion avoidance. If the wall thickness is >1.5 mm, replacement aluminum studs can be welded after the damaged stud has been removed and the joining zone has been cleaned. Further reprocessing solutions such as MIG weldable aluminum plates with replacement aluminum drawn arc weld studs already attached can be used. If the walls have larger holes, then weld a stud to a similar piece of coupon and attach the coupon to the part.

What are the key functions of a drawn arc weld Ground Stud Assembly (Earth Stud)?

For quality control, the nut has a removal torque requirement (a.k.a. break-away torque) before paint. The stud and nut flange design serves 4 functions. See **Graphic 4**.

1. The clamp load is generated against the flange providing a strong joint without putting the weld zone in tension.
2. The nut is seated flush to flange preventing the intrusion of paint onto the grounding surface.
3. The octagon shape provides the opportunity, in a production environment, to quickly test the weld using existing tools without changing the break-away nut torque.
4. The octagon can be used for anti-rotation with appropriately sized winged terminals that are currently available. ■



Graphic 4.
Ground Stud Assembly (Earth Stud)

