ALUMINUM UHV TIG WELD DESIGN

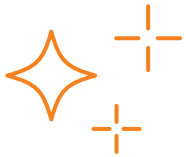
Reference this guide to design and weld aluminum and aluminum-to-stainless bimetallic flanges, fittings and transitions to meet UHV standards.

DESIGN WELD GEOMETRIES USING SIMILAR MASSES

If a large mass differential exists between the components being welded, say a chamber and a flange weld neck, the larger of the two will be cooler, leading the other to preferentially melt. If similar masses are not possible, thermal chokes can be machined into the more massive part to constrain heat loss. Burying a less massive component into its larger mate will also distribute heat in a more uniform manner and facilitate the welding process.

FILLER IS REQUIRED TO PREVENT CRACKING

Weld preps should accommodate the addition of filler rod. In the case of butt joints, 'V' grooves should be added. On thin walls, the 'V' should extend about 2/3 of wall thickness. Continuous welds should be positioned at the joints that will be exposed to vacuum, to prevent virtual leak pathways.



KEEP IT CLEAN

Make sure that weld surfaces, including filler rods, are freshly cleaned, and completely dry. Even though aluminum instantaneously forms an oxide in air, a freshly abraded surface can reduce oxide thickness and contaminants. We recommend degreasing with soapy water (like Joy dish soap) and removing the oxide scale with Citranox or a similar acid detergent soak. Immediately before welding, remove thin oxides on the parts and filler rod using a stainless wire brush or Scotch Brite. Then wipe with alcohol. Thorough cleaning is important, as contamination and oxide will diminish the vacuum integrity of the weld.

PREHEATING

Because of aluminum's excellent thermal conductivity (10x that of stainless steel), extreme heat is required when beginning a weld. Then weld temperature must be reduced as the heat spreads ahead of the weld puddle and begins to accumulate in the part. Leaks tend to occur in start and stop points. Therefore, we recommend using a foot pedal controller to feather current as heat accumulates, particularly upon stopping to fill the crater. Unlike stainless steel which glows orange at welding temperature, aluminum does not change color. It is critical to observe the molten aluminum weld puddle to control the melt and solidification process. Once a weld puddle has been established, welding must occur quickly to prevent melting through the weldment and overheating the dissimilar metal bond.

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Atlas TECHNOLOGIES

UHV TIG WELD RECOMMENDATIONS

ALUMINUM THICKNESS UNDER 1/4" (6mm)

Ideal for tube to tube and Atlas CF Flanges fitted with weld-neck (WN) geometries.

MODE	AC (cleans oxides)
CURRENT	75-185A (foot pedal control)
GAS*	Thin sections: 100% argon. Thick sections: 75% helium / 25% argon.
GAS FLOW	15 to 25 CFM
GAS LENS	Optional
ELECTRODE MATERIAL	2% ceriated tungsten
ELECTRODE TIP	3/32" (2.38mm). Sharpen electrode tip to short, blunt taper.
FILLER ROD	4043 1/16" (1.58mm). Filler rod 5356 if parts are to be anodized.
WELD APPEARANCE	Bright metallic with no soot. Yellow discoloration results from oxygen-contaminated helium.
PEAK TEMPERATURE AT BOND	300°C (<2 minutes during weld-up). Keep damp rag on bimetallic bond joint to prevent overheating during welding.
POROSITY	Dirty parts, dirty filler rod, or tungsten contamination may result in weld porosity and leaks.

ALUMINUM THICKNESS OVER 1/4" (6mm)

Ideal for flange to chamber and Atlas CF Flanges with flush-mount (FM) geometries.

MODE	AC (cleans oxides)
CURRENT	125–200A (foot pedal control)
GAS*	75% helium / 25% argon
GAS FLOW	30 to 40 CFM (or more depending on weld bead size)
GAS LENS	Optional
ELECTRODE MATERIAL	2% ceriated tungsten
ELECTRODE TIP	Small Bead: 3/32" (2.38mm). Large Bead: 1/8" (3.18mm). Sharpen electrode tip to short, blunt taper.
FILLER ROD	4043 1/16" to 1/8" (1.58 to 3.18mm). Filler rod 5356 if parts are to be anodized.
WELD APPEARANCE	Bright metallic with no soot. Yellow discoloration results from oxygen-contaminated helium.
PEAK TEMPERATURE AT BOND	300°C (<2 minutes during weld-up). Keep damp rag on bimetallic bond joint to prevent overheating during welding.
POROSITY	Dirty parts, dirty filler rod, or tungsten contamination may result in weld porosity and leaks.

***Because of the high thermal conductivity of aluminum, you want to form a puddle quickly before the heat dissipates into the bulk metal. Helium concentrates heat for faster puddle formation, therefore we recommend a 75% helium / 25% argon shield gas mix. Practice first and use caution on critical joins.**