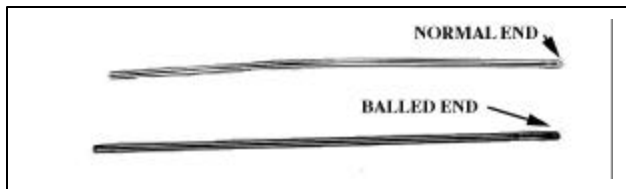


(This is a two-part document, with general tig welding first followed by one aluminum-specific.)

TIG WELDING TIPS

by
Tom Bell

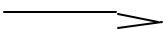
1. The bigger the rod, the easier it is to feed. Use larger diameter rods (3/32" to 1/8") when learning if possible.
2. Rod angle and torch angle should not be the same because the heat will bounce off of your part and melt the rod before you want it to. Slide rod in under heat. Rod needs to be pushed into the pool not drawn in by the heat of the arc. Don't let the heat draw the rod into the pool or you'll never get consistent results. (See Tip #5 in the TIG Welding of Aluminum Tips handout).
3. If a ball forms on the end of your rod when welding (see picture below of actual rods) you are doing something wrong. The problem could be incorrect rod to torch angle or not being aggressive enough (see #2 above). When feeding rod, make sure you push your rod into the welding pool.



4. 2° tungsten electrodes are mildly radioactive. Wear a respirator when grinding.
5. Use smallest tungsten to get the job done. Too big of an electrode can cause an erratic arc and contamination due to insufficient current flowing through the electrode to make the arc stabilize.
6. Tig and Mig wire are the same, i.e., one can use Mig wire to Tig weld in a pinch.
7. Aluminum takes a lot of heat to weld. Don't be afraid to increase welding current. Welding with the machine on the "hot" side will allow you to increase welding speed. A "hot" machine plus fast travel speed means less heat input into the part and lessens the possibility of distortion and/or burn-through. A "cold" machine plus slow travel speed means more heat input into the part and increases the possibility of distortion and/or burn-through.
8. Shielding gasses for Tig:
 - 100% Argon – coolest gas (most common gas)
 - 75% Argon/25% Helium – next hottest gas
 - 75% Helium/25% Argon – hot gas. Higher percentages of helium in the gas can cause arc starting problems
 - 100% Helium – real hot gas. Hard to start arc.
9. When Tig welding, material has to be clean; no rust, scale, paint, etc. No drafts in the welding area or you will lose shielding (pinholes in the weld).

10. Set the machine so you are at welding temperature with the foot pedal depressed 3/4 of the way. The 1/4 pedal that you have left is in reserve. This technique allows you to trail off the arc gently at the end of the weld (ending the arc suddenly can cause the weld to crack).
12. The higher the amps, the larger the orifice needed in the cup (nozzle). Too short of a tungsten stickout from the cup will act as a governor and you will not be able to get enough heat out of your welder when welding aluminum. (See Tip #23)
13. Use gas lenses to weld stainless steel. The screen in the gas lens allows far better gas coverage of your welds. You can use gas lenses to weld all materials is you want; they also allow you to stick your tungsten up to 1" out of the cup by increasing gas flow. The screen diffuses gas at higher gas flow rates eliminating turbulence which is what you would get if you tried this without the gas lens. Too much gas is as bad as too little gas. Typical gas flow rates are around 15 to 20 cfh.
14. Tungsten size is not always dependent upon metal thickness. Some variables are: material type, size of parts, are parts laying on a table?, joint type.
15. Not all alloys of aluminum are weldable. For example: 7075, 2024 if parts are to be anodized after welding, use 5000 series rod. For example: 5356, 5183, 5556, etc., 4000 series welds are anodized will turn black.
16. If your tungsten begins to wiggle during welding, this means your tungsten is near its capacity. This can be minimized by using the balance dig dial. The more to the cleaning side is the positive side of wave means more heat is on the tungsten tip = more wiggling. The more to the penetration side, the more the arc is on the negative side. Less heat on tungsten tip, less cleaning action but the square wave provides plenty of cleaning even in max penetration mode. Higher the number, less cleaning and more penetration and less heat on the tungsten. This applies to square wave machines. Older sine wave machines have no adjustments for this, you preheat material, use hotter gases to take heat off of the tungsten.
17. Tungsten profile has a substantial effect on bead shape, width, penetration – so experiment. Tungsten grinds longitudinally, not circularly.

Long taper:  Heat is concentrated in small area.

Decreasing taper:  Arc spreads out more.

Round:  Heat flares out (for AC on aluminum).

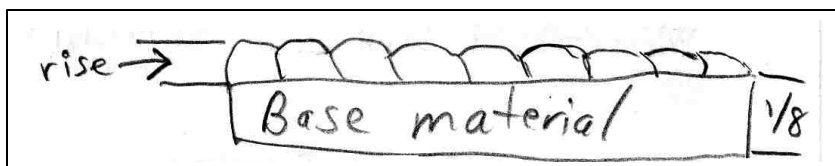
Experiment with this and different torch angles to see variations in weld size and depth of penetration.
Practice!

18. Torch angle effects penetration. The more vertical the torch is, the more arc is directed into the part.
19. Wear thin gloves on the rod feeding hand. You need maximum feel to feed rod properly. Learn to feed rod out with “pencil” fingers and thumb.

20. Put a vent hole in any weldments that will be welded completely or air will heat up and expand and blow away your shield or blow out at the end of the weld bead. Some machined joints that are sealed on one end will not allow you to start weld because the fit is so good it is air tight before you weld.
21. Get filler metal charts to let you choose correct rods for whatever materials you are welding. Go online for welding information.
22. Write down what works and doesn't work. This way you can refer to it.
23. Let tungsten protrude out of cup 1/4" to 5/16" when welding high amp aluminum or heat will radiate from the cup to tungsten and reduce output, especially if the orifice is too small.
24. Put a glove, wood, or something non-conducting on the welding table to protect your arms from shocking hazard. Sweat can aggravate this problem. Rest your torch hand on a steady object for better results.

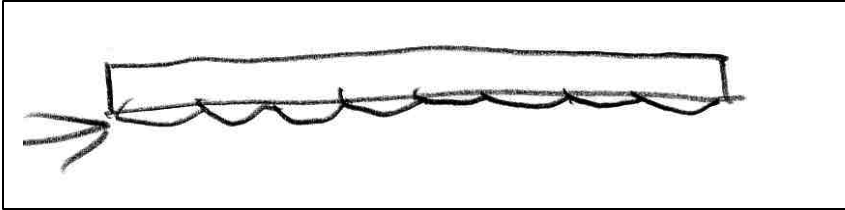
TIG WELDING OF ALUMINUM TIPS by Tom Bell

1. Aluminum requires a lot of heat to weld. Example: 1/8" Aluminum open corner joint requires a machine setting of about 130 amps using AC current. The pedal should be 3/4 of the way down during welding. Zero to 1/2 pedal will allow you to light the arc without melting material and trail off arc gently. Three quarter to wide open allows operator to have amperage in reserve.
2. When using AC current on aluminum, the material will become shiny when it is ready to accept a filler rod. The material will not accept filler metal if it is not shiny. Watch the area closely underneath your tungsten rod until you see it get shiny. Exception: DC welding aluminum with helium shield pool does not change color – it sinks.
3. When you add rod to an aluminum weld, the pool will rise. See picture below:

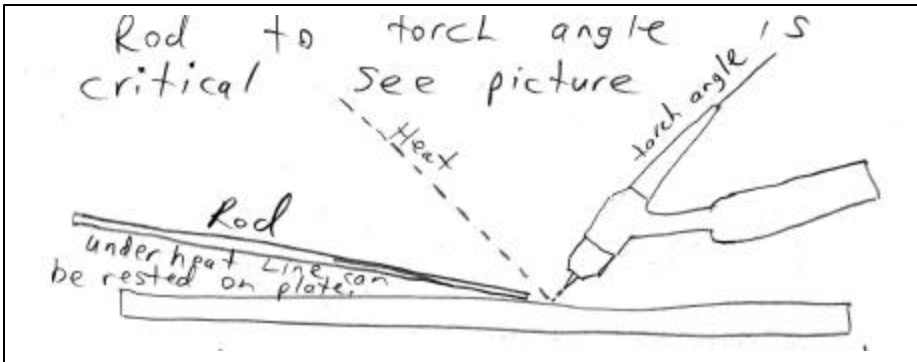


Take this into account when you position your tungsten over your part or else your weld will rise up and contaminate your tungsten electrode.

4. When welding aluminum if you don't see reinforcement above your plate, one of two things is happening.
 #1 – you are adding in insufficient rod.
 #2 – you have gotten material too hot and your weld has sunk. This is called burn through See the picture below:

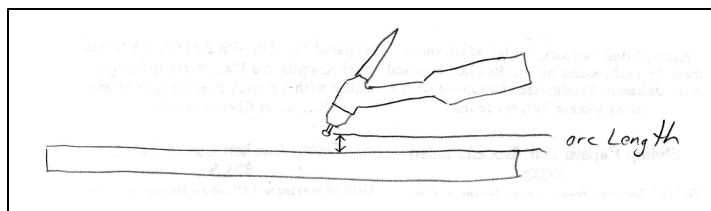


5. Rod to torch angle is critical. See picture below:




Heat will reflect off of your part and melt your rod if you are not aware of it. Slide rod in under heat. Rod needs to be pushed into the pool not drawn in by the heat of the arc or you will never achieve uniformity. This applies to any process in which you have to manually feed in a rod with your hand. Rod and torch angle should never be the same if it can be avoided.

6. All materials should be as clean as possible before your start welding. Use a stainless steel wire brush to remove oxide layer and mark the wire brush for aluminum only.
7. Keep your arc length as short as possible. Arc length is the distance between the tungsten and the workpiece. See picture below:



The more stable your hand is the closer you can get. Different arc lengths can be used for different materials. Experiment. Less heat is inputted when your arc is short, Your arc is concentrated in a smaller areas. Welding with higher amps and shorter arc will input less heat into part than a long arc and less amperes. The hotter you weld the faster you can go, within reason.

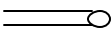
8. Tungsten profiles change arc characteristics.

Long taper: 

Heat is concentrated in small area.

Decreasing taper: 

Arc spreads out more.

Round: 

Heat flares out (for AC on aluminum). Magnesium.

Experiment with this and different torch angles to see variations in weld size and depth of penetration.

9. The smaller the rod, the harder it is to feed. Start your welding with larger rods (for example 3/32" or 1/8").
10. Certain alloys of aluminum don't weld or bend. Know what your are welding. Download information on aluminum alloys off of the internet for your information. 2024 and 7075 are not weldable. 5052, 3003, 1100 are bendable soft alloys. 6061, 7075 will bend but not in tight radius. Research out your materials.
11. Welding on aluminum castings:
- A. Grind off sand from rough castings. Smooth in areas to be welded. There are grinding wheels for 4-1/2" and larger grinders made specifically to grind aluminum.
- B. Castings that are dirty or oily need special care. You can plasma cut a crack out if possible. This cleans out the oil in the crack. Drill holes at the ends of cracks or they will continue on after the repair is made. Clean the surface with alcohol or similar cleaner. Carefully heat the area with a oxy-acetylene torch to cook out the oil. Go over the crack with the TIG torch with low heat. Use a small tungsten electrode. These are called cleanup passes. Do not add welding rod. Every time you go over aluminum it should get cleaner. You will see black discolored aluminum in the beginning. Weld; grind; weld; grind. Eventually the aluminum will be shiny silver color, then you can weld with rod and larger tungsten.
- C. You can use sanding discs on aluminum to metal finish; spray WD40 on the disc and the part to keep it from loading up.