A Beginner's Guide to TIG Welding

TIG Welding Names

TIG Welding, or TIG, is an acronym for "Tungsten Inert Gas" welding. TIG is a commonly used and accepted slag term. The proper terminology is "Gas Tungsten Arc Welding" or GTAW. This is the term used by welding engineers on blueprints, and in welding procedures. When TIG was introduced around the 1940's it used to be referred to as "HeliArc" because the shielding gas used was helium. It is no longer called HeliArc because in most cases the shielding gas used is Argon.

Weldability of Metals

TIG welding is the most versatile welding process used today. Chances are if it is made of metal it can be TIG welded! This process is typically used for two reasons and they are Quality and Weldability. When it comes to Weldability of exotic metals no other process can do the job as well for the price. This makes TIG welding perfect for machine shops or anyone who works with a variety of metals. The results are also excellent when it comes to quality. TIG is typically used for welding pipes and pressure vessels in nuclear power plants and shipyards because of its controllability. The high degree of controllability inherent with TIG welding produces a significantly higher quality weld than with any other commonly used method available today. Some of the metals that are commonly TIG welded are:

1. **Mild Steel**
2. **Stainless Steel**
3. **Aluminum**
4. **Copper**
5. **Nickel**
6. **Copper Nickel (CUNI)**
7. **Inconel**
8. **Magnesium**
9. **Hastelloy**
10. **Titanium**

The TIG welding process can weld many more metals and alloys. On top of that, it can also weld many dissimilar metals together.

Power Supply and Equipment

The power supply used for TIG welding is a CC or "Constant Current" power supply just like Stick welding. In most cases it is the same power supply! TIG welding requires constant amperage to maintain the arc, while the voltage is what fluctuates depending on the arc length. What changes a stick welder to a TIG welder? Just a few adjustments to the bells and whistles! One would only need to play with the bells and whistles on a machine for the purpose of welding Aluminum, which requires AC or "Alternating Current". Outside of welding Aluminum

there is rarely a need for anything else but DC or “Direct Current”. Bottom line, TIG welding works well with any DC Stick welding power supply. For example, on most industrial construction sites they use Stick welding power supplies for the majority of TIG welding.

The equipment for basic TIG welding is a DC power supply, TIG torch, and a gas regulator connected to a bottle of Argon gas. That’s it! For less than $200 you can convert a DC stick welder into a TIG welder.

The way this equipment works together is simple. The TIG torch is connected to the negative (-) side of the power supply and the ground goes on the positive side (+). This allows the electricity to flow from the torch to the work. Then the Argon hose is attached to the regulator and set. Once everything is hooked up, you need to insert your Tungsten into the TIG torch. After the Tungsten is secured, turn on your power supply and Argon gas. What happens is the gas flows through the torch, shielding the weld area and then you simply strike an arc. Subsequently, the puddle forms and you add filler wire to the joint with the other hand. Voila!

As for additional equipment, there are foot pedals to regulate amperage, high frequency starts, square wave AC and pulse controls to make welding easier. Again, unless you are welding Aluminum, this is unnecessary equipment that takes a simple process and makes it complicated. As for welding Aluminum, an AC power supply with a high frequency start is all you need.

Shielding Gases

TIG welding offers two options where shielding gasses are concerned:

- **Argon**
- **Helium** *(in rare cases)*

It is extremely rare to employ helium because it’s expensive and it rises – meaning when you’re welding you want the gas to flow downward, unless you are welding in the overhead position of course! In most cases, Argon gas is used because it works with any metal and is the only gas needed.

TIG Cup Sizes

The cup sizes vary on a TIG torch. It all comes down to the size of the weld joint that will be made. What the cup does is provide shielding gas coverage to the weld joint. The basics of TIG cup sizes are easy. These cups have a coding system to identify them, and there is a number assigned to each size. The cup sizes work like this:

- Size 4 = 4/16 inside diameter
- Size 5 = 5/16 inside diameter
- Size 6 = 6/16 inside diameter

- Size 7 = 7/16 inside diameter

The whole coding system converts the sizes into numbers based on increments of 1/16 of an inch.

Tungsten Electrode Selection

Tungsten is what makes TIG welding possible. When it comes to Tungsten selection there are many choices, but the reality is one type can do almost any kind of welding. To keep things simple you need to choose the size and the type of Tungsten. For basic welding, a 3/32 diameter electrode with 2% Thorium Tungsten will do the trick (2% Thorium Tungsten has a red painted end). This type of Tungsten works well with almost any metal, and the size is just right to weld thin as well as thick metals.

Electrodes or Filler Wire

Electrodes, or filler wire, come in rod form typically 36 inches long. This filler wire comes in a variety of sizes that are typically:

- **1/16**
- **3/32**
- **1/8**

The electrode size has little to do with the thickness of the metal that will be welded if what you're talking about is TIG welding. What *does* matter is how much filler metal you want to ad at any given time for the specific requirement of the weld (i.e. you can feed the wire, start a small puddle and quickly pull a thin line, or you can feed much more wire, hold the torch steady thereby creating a much wider puddle to work with). With TIG welding the filler wire is always added to the joint with the opposite hand, which gives you full control over the deposit rate and weld size.

The electrodes have a coding system to identify them. A commonly used electrode for mild steel is **"ER 70S-2"**

- **"ER"** stands for electrode or filler rod.
- **"70"** is the strength of the weld. In the case of mild steel, the weld has a minimum of 70,000 pounds of tensile strength per square inch of weld.
- **"S"** stands for a solid wire. Since the wire is solid it always needs a form of shielding gas.
- **"2"** represents the amount of cleaner that is added to the wire to improve weld quality.

If you have MIG welded before, these designations might sound similar. The filler wires for MIG can also be used for TIG welding. It comes down to the first designation "ER"; electrode or filler rod.

Welding Machine Set-Up

Before setting your TIG welder there is some preparation work that needs to be done first. The weld joint must be absolutely clean! That means no rust, paint, oil or anything else. Absolutely nothing but bare shining metal. Although TIG is an excellent welding process, it must be stressed most emphatically

that the joint must always be clean - pristine! Additionally, Tungsten electrodes need to be sharpened to a fine point for all metals except Aluminum. A clean joint and clean sharp Tungsten rod are always needed. No Exceptions!

To set-up for welding there are three main steps:

1. **Torch Set-Up**
2. **Gas Flow**
3. **Machine Set-UP**

The torch body has four main parts plus the Tungsten electrode for set-up. The torch body holds the collet body, collet, back cap, and cup. All of these parts are what hold and shield the Tungsten electrode. The set-up of the torch requires having the proper size collet and body to match the Tungsten size that will be used. The cup size is chosen based on the size of weld that will be done and the back cap is what tightens the Tungsten. Once these are all in place you need to set the Tungsten to stick-out just enough to keep the weld shielded from the air and far enough to see the arc. This is something that every welder does differently. There is no right or wrong formula as long as it does the job.

Gas flow rate is regulated in CFH "Cubic Feet per Hour". Set-up of the gas flow rate varies depending on the cup size and any draft or wind conditions. If you are in a shop that has no drafts, a rate of 5 CFH may be enough. However, 60 CFH may not be enough if you are welding outdoors. It all comes down to the conditions at the moment. A higher gas flow rate is not good either because it causes turbulence that will pull air into the weld.

Machine set-up is pretty simple! All you need is enough amps to create a puddle in a second or two. The rest is all technique with a clean joint and Tungsten!

TIG Welding Technique Basics

TIG welding techniques are simple but a lot of skill is needed to do it right! Before you get caught up in technique there are some rules that need to be followed. First, a clean joint is not negotiable. Second, clean Tungsten is a must. These two rules are what separate master craftsman from the wannabees! No joke! Case and point - I trained under two welders who won the "World's Best Welder" title and they would not weld a dirty joint. It comes down to this, you can take the best welder and techniques on a clean joint and produce a perfect weld but that same welder using the same techniques could not even get the puddle to flow on a less-than-perfect joint! When TIG welding it's all about having a clean weld joint and clean Tungsten. These rules even apply to a joint that was cleaned and has one weld pass, but the color has changed on the metal to that 'blue-ish wave' we all are familiar with. The best solution before welding in this case is filing down the weld area to clean metal.

Basic TIG welding techniques are simple. To start an arc you need to either bump the Tungsten or scratch it. All you need is a puddle to form and then add filler wire to the joint. That is it! It

does not matter if you go forehand or backhand. TIG is all about washing the weld into the metal. As for positions, it does not matter if you are welding flat or overhead, the metal always flows in the same way.

The main difference in TIG welding techniques comes from the equipment that is used. If you are using a basic TIG set-up you need to move faster as the weld becomes fluid. In case you have a foot pedal then you would ease off the amperage to compensate for overheating the metal.

A Beginner's Guide to TIG Welding was written exclusively for Metal Web News.Com and their readers by Go Welding.Org