

# Introduction

This is a basic guide to welding electrodes, filler metals, and tungstens. Below you can find information separated by welding process for the different filler metals as well as an explanation of the usual formatting of the designations.

## SMAW / Stick

Stick welding electrodes are classified with a single letter and four numbers. This is formatted like E6010 or E7018 with the different numbers changing the designation code.

- The letter “E” indicates that this is an electrode.
- The first two digits indicate the minimum tensile strength of the weld. This is measured in psi. A rod designated with a 60 at the start will make a weld with a minimum tensile strength of 60,000 psi.
- The third digit indicates the electrode’s working positions. 1 means all positions while 2 means horizontal and flat only. 3 and 4 codes also exist, but should be ignored for anybody who doesn’t work in fields that utilize them.
- The fourth digit indicates the coating type and the polarities (DCEP, DCEN, AC) that the welding rod can be used with.

Common Rods:

E6010 - A deep penetrating fast freezing rod with a cellulosic flux. They are commonly used for open root welding. They produce heavy spatter and a lot of heat. Can only be used with DC power sources.

E6011 - Similar to an E6010 electrode, however E6011 is able to be used with an AC power source.

E6013 - A soft arcing rod with shallow to moderate penetration and minimal spatter. Very thin E6013 electrodes can be used for welding sheet metal. Has a slightly runnier flux than other rods that form a slag cap.

E7014 - Shallower penetration profile with a high deposition type flux, designed for use on low carbon and low alloy steels. They can be utilized at a higher amperage.

E7018 - Low hydrogen rods that must be baked to keep moisture out of the flux. Produce a smooth and quiet arc with medium levels of weld penetration. Forms a slag cap that can peel itself if the weld is good enough. Considered a more popular rod due to its welding performance.

E7024 - High deposition rod with an iron powder flux. Typically used for high speed horizontal or flat fillet welds.

## Wire Feed Welding (GMAW / MIG)

Unlike stick welding, wire welding provides its filler metals through a spool-fed wire. There are two primary categories of wire for use with a wire welding process. One category is solid wire

(used by GMAW & MIG) and the other is flux cored (used by FCAW). The designations for wire are formatted a little differently than stick, with an example being ER70S-6.

- GMAW wires typically use the ER designation, meaning Electrode Rod.
- Like stick, the first two numerical digits indicate the tensile strength and use the exact same system.
- The “S” stands for Solid wire.
- The final numerical digit indicates chemical additions to the wire’s composition to facilitate different welding conditions.
- Alloys not used for welding mild or carbon steel do not always follow this format.

Common Wire Examples:

ER70S-6 - This is a standard mild steel wire, commonly seen anywhere from 0.023” to 1/16”.

ER5056 - A common designation of aluminum wire.

ER308 - One of the many types of stainless wires.

## Wire Feed Welding (FCAW)

Unlike stick welding, wire welding provides its filler metals through a spool-fed wire. There are two primary categories of wire for use with a wire welding process. One category is solid wire (used by GMAW & MIG) and the other is flux cored (used by FCAW). The designations for wire are formatted a little differently than stick, with an example being ER70S-6.

- Unlike GMAW, FCAW wires only utilize the “E” designation. This means Electrode.
- Instead of S for solid wire, you will instead see “T” or “C”. These refer to tubular and composite respectively.
- In the first two numerical digits, the first number refers to the tensile strength while the second refers to the positions the wire can be used in. E70C-6 has 70,000 psi of tensile strength and can only be used in the horizontal or flat positions. E71T-8 also has 70,000 psi of tensile strength, however it can be used in all positions.
- The third numerical digit on a flux cored wire shows its usability specification, typically referring to its slag composition.
- Some forms of flux core can require gas like wire welding. Please refer to the manufacturer’s instructions for your wire to figure out if gas is required for your wire or if it is self shielded.

The most common flux core wire the average hobbyist will run across is E71T-11. This is a self shielded flux core wire that is good for all positions.

## GTAW / TIG

Unlike other processes, electricity does not flow through the filler metal for GTAW. Instead an arc is struck between a torch that utilizes a nonconsumable tungsten electrode and the base metal while a filler metal rod is dipped into the weld puddle to introduce filler metal. At lower amperages, the torch can also be used for brazing.

- GTAW filler metals use the same classification system as solid wire utilized for wire feed welding. As they are the same alloys, you can use GMAW wire of the appropriate designation for TIG welding instead.

Common GTAW Rods:

ER70S-2 - The form of mild steel rod that's more common for GTAW.

ER308L - The most common stainless steel rod, used most often for welding some 300 series stainless.

ER4043 - The most common aluminum TIG welding rod. Often used for welding either 4043 or 6061 alloys.

ERCuSi - Silicon bronze rod used for either welding bronze alloys or TIG brazing.

## Acetylene Welding (OAW) / Brazing (OFB)

Functionally similar to TIG, except instead of an arc welding torch an acetylene torch is used instead. Acetylene welding rods follow a fairly simple designation system and cannot usually be used for other purposes. When utilized for brazing, an acetylene flame is not strictly needed unlike with welding.

- OAW rods begin with the designation of RG, meaning Rod Gas.
- The final two digits are the tensile strength, written the same way as solid wire for GMAW/GTAW.
- Rods for OFB tend to have more esoteric designations such as 15FB, LFB, or Silvaloy 560. Usually their designations are up to the whims of the company producing them.

Common rods:

RG-45 - The most common welding rod for mild steel used with the OAW process.

15FB - Standard flux coated low fuming bronze rod used for oxy-fuel brazing.

## GTAW Tungstens

A topic that is as endlessly argued over as the true lore behind the origins of varying Star Wars details, GTAW tungstens are an endless source of discourse. Each and every person has their own opinions on what type of tungsten is best. There are usually considered to be six categories of tungstens on the market currently.

- Pure tungsten electrodes utilize green paint as their designation. This type of tungsten is only to be used with a transformer based constant current power supply. Balls easy, tends to spit at high amps.
- Ceriated tungstens utilize grey paint for their designation. These are best for AC applications or DC applications with an inverter based power supply. Best at low amperage ranges and has low erosion.
- Lanthanated tungstens have two paint colors - gold for 1.5% lanthanated and blue for 2% lanthanated. These are usually considered one of the best general purpose non-radioactive tungstens on the market.

- Thoriated tungstens have red paint. This is a radioactive electrode utilizing thorium oxide as its alloying agent. Thoriated tungstens can be sharpened to a little bit sharper of a tip on account of being slightly more durable, however practice sharpening other types of tungstens typically eliminates this advantage. Has the best arc starts according to its fans.
- Tri-Mix, E3, Rare Earth, and LayZr are all generally the same categories of tungstens. Their paint color seems to be slightly nonstandardized, however Tri-Mix are typically cyan, E3 are typically purple, and LayZr are chartreuse. These electrodes use advanced metallurgy to find what is advertised to be the optimum conditions for machine welding. The writer of this whole guide uses Tri-Mix for their own welding purposes in spite of this as they're cheap.