Tungsten - Melting Point

Melting point of Tungsten is 3410°C.

Note that, these points are associated with the standard atmospheric pressure.

In general, melting is a phase change of a substance from the solid to the liquid phase. The melting point of a substance is the temperature at which this phase change occurs. The melting point also defines a condition in which the solid and liquid can exist in equilibrium. Adding a heat will convert the solid into a liquid with no temperature change. At the melting point the two phases of a substance, liquid and vapor, have identical free energies and therefore are equally likely to exist. Below the melting point, the solid is the more stable state of the two, whereas above the liquid form is preferred. The melting point of a substance depends on pressure and is usually specified at standard pressure. When considered as the temperature of the reverse change from liquid to solid, it is referred to as the freezing point or crystallization point.

The first theory explaining mechanism of melting in the bulk was proposed by Lindemann, who used vibration of atoms in the crystal to explain the melting transition. Solids are similar to liquids in that both are condensed states, with particles that are far closer together than those of a gas. The atoms in a solid are tightly bound to each other, either in a regular geometric lattice (crystalline solids, which include metals and ordinary ice) or irregularly (an amorphous solid such as common window glass), and are typically low in energy. The motion of individual atoms, ions, or molecules in a solid is restricted to vibrational motion about a fixed point. As a solid is heated, its particles vibrate more rapidly as the solid absorbs kinetic energy. At some point the amplitude of vibration becomes so large that the atoms start to invade the space of their nearest neighbors and disturb them and the melting process initiates. The melting point is the temperature at which the disruptive vibrations of the particles of the solid overcome the attractive forces operating within the solid.

As with boiling points, the melting point of a solid is dependent on the strength of those attractive forces. For example, sodium chloride (NaCl) is an ionic compound that consists of a multitude of strong ionic bonds. Sodium chloride melts at 801°C. On the other hand, ice (solid H2O) is a molecular compound whose molecules are held together by hydrogen bonds, which is effectively a strong example of an interaction between two permanent dipoles. Though hydrogen bonds are the strongest of the intermolecular forces, the strength of hydrogen bonds is much less than that of ionic bonds. The melting point of ice is 0 °C.

Covalent bonds often result in the formation of small collections of better-connected atoms called molecules, which in solids and liquids are bound to other molecules by forces that are often much weaker than the covalent bonds that hold the molecules internally together. Such weak intermolecular bonds give organic molecular substances, such as waxes and oils, their soft bulk character, and their low melting points (in liquids, molecules must cease most structured or oriented contact with each other).

Why does my TIG electrode melt? - Welding Mastermind

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Especially if you are new to TIG welding, you might have encountered the “balling up” of your TIG electrode. A TIG electrode normally lasts a while before it needs to be sharpend or replaced, so if you experience melting on your electrode, this article might help you to shed some light on the issue.

TIG electrodes melt due to a variety of reasons, the most common are: diameter of the electrode too small for set current, the polarity of the torch is clamped electrode positive, welding with DC instead of AC or the electrode material is not suitable for the welding setup.

In the following article, I will go into a bit more depth for these main causes which hopefully helps you to fix your electrode problem!

Background Information (First time welders start here)

To understand why your tungsten tip is melting, we should have a brief look at the underlying principles in Leymann terms to be in a better position to narrow down the cause of the problem. If you are already fairly familiar with the physics behind tig welding, feel free to skip to the next section.

In TIG welding, electrones are travelling between the electrode and the workpiece through a so called arc. This arc is a plasma that allows the electrodes to travel. Note that the shilding gas you are using is helping to create this plasma, and makes it much easier to form than in “regular” air. The electrodes can either flow from the torch to the workpiece (which is called electrode negative) or from the workpiece to the torch, which is calles electrode positive. I will get into more detail on the polarity and its effect in the polarity section.

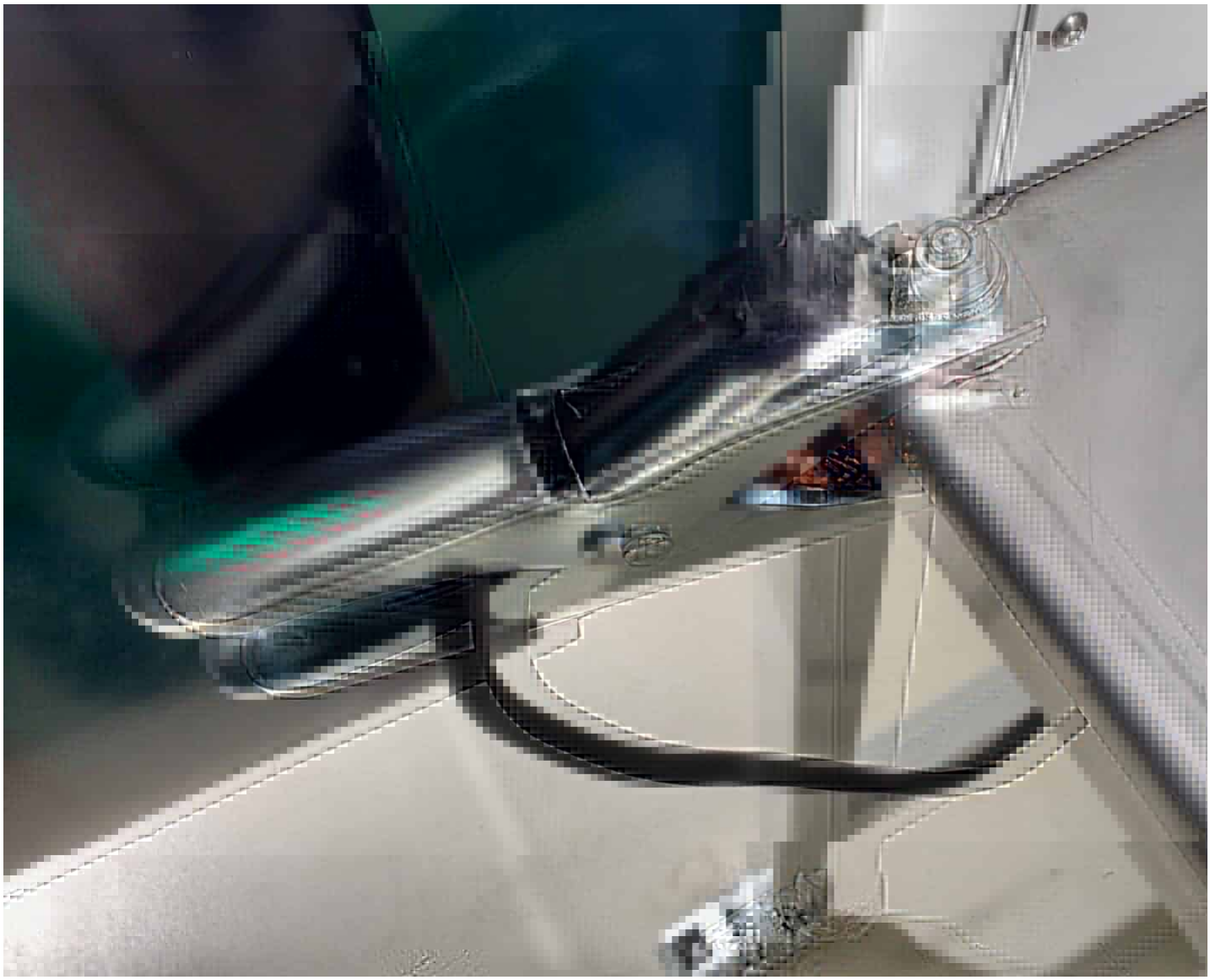
And last but not least, we have the choice between alternating current (AC) and direct current (DC). When utilising direct current, the welding setup is either electron negative (DCEN) or electron positive (DCEP). It gets interesting though when you use alternating current, because that is basically sending electrodes in both directions for a very short period of time before switching to the other direction of flow. Alternative current welding is generally utilised for aluminium welding. More in the next section. But before I lose myself in the technical details, lets get into the practical stuff.

Why does my electrode melt when welding Aluminium?

When you weld Aluminium, you will face an additional challenge which you are not encounting when you are welding most ferrous metals. Aluminium has an oxide layer that reforms in split seconds when exposed to oxygen (air). This is a bit like a protective rust. That is why Aluminium is not rusting like iron, the oxid layer protects the Al from direct contact with environmental oxygen (e.g. air). But for welding, this layer has to be removed, otherwise your weld results will be poor at most. The beads will look everything but shiny and even, and contamination with oxides, which are harmful to the mechanical properties of your weld, are certain. Also oxides are ceramics, which have a melting point at around 2000Â°C in contrast to 660Â°C melting point of Aluminium itself. Just by looking at the numbers you can see that you will hardly be able to create a nice weld pool with these two contrasting elements.

So whats the fix? Breaking the oxide layer up! Basically, what you can do through setup is using the TIG torch as an electrode shooting device, which breaks ups the oxide layer. This cleaning mode allows to remove the oxides and weld the aluminium. Do not mistake, the oxide layer will be back the moment you stop welding that section, but this is sufficient for welding purposes and actually helpful for rust protection as mentioned above. For more details on the influence polarity has, check the polarity section.

Polarity – Pole it right!



When you are welding and your tungsten tip is balling up or melting, chances are high that you have the polarity wrong. When the electrode is poled electrode positive (DCEP), the tungsten tip will be heating up quite quickly, generally visible through glowing colours. If you are welding direct current, and this is happening to you, change polarity to electrode negative (DCEN). That should do the trick if polarity for direct current welding was your issue.

If welding Aluminium, welding with alternating current (AC) is recommended. Not every welding plant has this feature, so if you can't find how to set AC on your welding plant in the manual, than this plant is not suitable for Aluminium welding. On the other hand, if your machine is set on AC and you still don't get the desired results, check the next section for the right balance.

Balance – finding the right one

The balance setting is responsible for the ratio between electron positve and electron negative phase. This setting is very different on every welding plant, and you need to consult your manual to set it up in the right way. Generally speaking, a ratio of 50:50 would equally distribute the two phases during welding. If you need more "cleaning", you would increase the electron positive phase, and if you like to get more penetration, you would increase the eletron negative phase. Finding the right ratio is dependend on a pletorra of variables, and needs to be determined case by case.

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Electrode size matters!

Whatever you heared somewhere else, size matters! A thicker tungsten electrode can resist a higher heat input. So if you have looked into all the other above mentioned areas, increasing your tungsten electrode diameter might prevent your tip from melting. For example, if you are currently using a tungsten size 1/16 you might consider moving one size up to 3/32.

Using different Electrode materials for better results

Similar underlying principle than for changing the electrode diameter would be changing the electrode material. Using Thorium, Cerium or Lanthanum in your tungsten gives you higher heat resistance, but it comes at a cost (financially and regarding the welding properties).

These were a couple of the most common resons why your tungsten is melting. Please keep in mint: This article can only explain the general principles, details may vary for different welding plants! Hope this helps you fixing your problem. Write me a comment if you have feedback or questions.

If you liked this article, have a look at my other articles I wrote about the topic!

Why Is My Tungsten Melting When Welding Aluminum? – Bescord

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Why did my tungsten melt?

Too large of tungsten for the given amperage can cause the arc to rotate around the tip, while too small of tungsten can melt and cause the arc to become unstable. Always follow the manufacturer's recommended welding parameters for each tungsten electrode diameter.

How do you prepare tungsten for aluminum welding?

- Sharpen one side of the pure-tungsten electrode to a spiky tip using a bench grinder.
- Put the sharpened electrode aside for 10 minutes, letting it cool down.
- Sharpen the other edge of the electrode to a point too, exactly like the other end.

What tungsten do I use for aluminum?

In summary, follow these three recommendations: Use a pure tungsten or zirconiated tungsten electrode when AC welding aluminum. Don't use a 2 percent thoriated tungsten electrode. Make sure you use a tungsten electrode large enough in diameter to carry the welding current you plan to use.

How do you know if tungsten is contaminated?

Why is my tungsten cracking?

the main cause of the splitting is getting the end too hot when sharpening it. you never want it to get red hot. cool it in water during sharpening if needed. the 3\32 tungsten is ok if welding aluminum you want to use 100% not 2% thoriated like on stainless.

Should you ball your tungsten?

What is the trick to welding aluminum?

- Pick the right tungsten electrode or rod—the best choice for aluminum is typically a pure tungsten rod.
- Take the time to prepare your aluminum by cleaning and preheating it.
- Ensure there is not too much argon flow at the torch, which can cause an irregular arc.
- To prevent warping, use a heat sink.

Can you weld aluminum with gray tungsten?

Grey electrodes perform well in DC applications and are great for welding titanium, copper, magnesium, aluminum, and nickel alloys, as well as non-corroding and stainless steels.

Can you TIG aluminum without high frequency?

Can you TIG weld aluminum without AC and a High-Frequency box? Yes, you can actually weld aluminum with a low-cost DC power supply.

How do you set up a TIG for aluminum?

What angle do you grind tungsten?

To grind the tungsten properly and to prevent contamination, it is preferable to use a grinding wheel especially designed for tungsten grinding, resistant to tungsten´s hardness. Grind the electrode straight on the direction of the wheel at a 90° angle and make sure that the grind marks are lengthwise.

Is purple tungsten good for aluminum?

This rare earth tungsten offers excellent ignition characteristics and consistent welding properties. They are universal and suitable for all applications in the whole range of AC and DC welding of non-alloyed and high-alloyed steel, aluminium, titanium, nickel, copper and magnesium alloys.

What is red tungsten for?

The EWTh-2 tungsten electrode is color-coded with a red band. It is known for its durability, ability to withstand high currents, and excellent arc starts. It is primarily welded using a negative polarity and direct current. It does not have great characteristics when welding with AC.

How do I prevent tungsten contamination and discoloration?

4. How do I prevent tungsten contamination and discoloration? Allowing the tungsten to touch the weld pool is one of the most common causes of contamination. This problem can be resolved by moving your torch farther away from the workpiece, which in turn lengthens the arc.

Does tungsten go bad?

A tungsten may fail in a single weld, or run 700+ cycles. One example of what can happen when an electrode goes bad is the 'roll back'. The weld may start normally, but part way through the arc does not follow the seam between the two pieces, and the edges do not join, but appear to roll back from each other.

Why does my TIG torch get so hot?

Running a torch beyond its recommended amperage rating can cause it to overheat. Lack of sufficient gas flow (air-cooled torches) or water flow (water-cooled torches) will result in an under-cooled torch. Using a power cable gauge that is too low will cause the wire to heat up and melt.

How do you sharpen tungsten?

How do you set up TIG tungsten?

- Connect Torch. When using an air-cooled torch, use the adapter from your accessory package and plug the torch into the front of your machine.
- Connect Remote Control.
- Connect Work Clamp.
- Select Polarity.
- Prepare Tungsten.
- Assemble Torch.
- Install Tungsten.

What is blue tungsten used for?

The blue lanthanated tungsten is the most popular and best general-purpose electrode for DCEN and AC welding. It provides significantly enhanced arc starts, excellent stability, and a wide amperage range.

Do you need AC to weld aluminum?

1. AC current is used to weld aluminum because its positive half cycle provides a "cleaning" action and its negative half cycle provides penetration.

What Rod do I use for aluminum TIG welding?

Some of the most commonly used alloys for TIG welding aluminum are 4043, 4047, 4943 and 5356. The 4xxx series filler metals share many similar characteristics. A 4043 rod is a good all-around filler metal for general fabrication.

What size TIG electrode should I use?

Most hand welding 'TIG torches require a 7.0" long electrode be cut in half to fit the manual welding torch.

Can you preheat aluminum before welding?

In general, preheat is never required to weld aluminum alloys. If you want to preheat, the temperature should be limited to 200 degrees F maximum. This sort of preheat often is useful to drive off condensation and moisture.

Can you weld aluminum with a Harbor Freight welder?

How do you weld aluminum with a TIG welder?

What is green tungsten used for?

Green TIG Welding electrodes are pure Tungsten and are used for AC welding, often for aluminum and magnesium. They tend to be commonly used because they are inexpensive. However, they also burn up much faster than the other alloy electrodes, so prepare to stock up if you go this route.

Do you TIG weld aluminum on AC or DC?

In general TIG inverters will be capable of welding either DC or AC/DC welding with very few machines being AC only. DC is used for TIG welding Mild Steel/Stainless material and AC would be used for welding Aluminium. The TIG welding process has three options of welding current based upon the type of connection.

When would you use a high frequency TIG welder?

Can you TIG weld aluminum with a DC welder?

DC GTAW can work very well on aluminum, so don't be afraid to try it. Just be aware that the technique is different than that used for AC. I recommend that you practice for a while before you decide to use it on actual components.

How many amps does it take to weld aluminium?

A common rule of thumb is that you will need 1 amp for every 0.001 inches of metal you are going to weld when other variables are constant. That means if you want to weld 1/8-inch aluminum, you will need around 125 amps when other factors are constant.

How hard is it to TIG weld aluminum?

TIG welding aluminum can be more difficult than steel; even with a simplified TIG welder like the Eastwood TIG 200 AC/DC. Aluminum tends to be less forgiving and there are some simple steps you can take before, during, and after the weld that can help you successfully weld aluminum.