



METAL 4: TIG WELDING

This guide briefly highlights equipment and protocol covered in TIG, Metal 4.

There are many different types of safety hazard produced by TIG welding. The main risks are from electric shock, welding fumes and radiation. Wear full protection when welding: A flame-proof welding jacket, gloves, welding mask, leather, closed toed shoes, and if possible, a respirator. Make sure the vent at your welding table is fully open when welding.

WHAT IS TIG WELDING?

TIG stands for Tungsten Inert Gas. At Open Works, **Argon**, an inert gas, is used as a shield to create an ideal atmosphere to produce an arc, and protect the weld components from contamination. TIG welding allows for a great amount of control and can be used for any type of metal including aluminum, nickel, and stainless steel. TIG welding can either be done autogenously, that is by melting and fusing the base metal, or by adding material with a filler rod.

Open Works has two types of welders that can be set up for TIG: Lincoln MPs and Miller's Syncrowave. The Lincolns only operate as a DC power source, and are set up by default for MIG welding, but can be configured for TIG. This is necessary for welding mild and stainless steel. However, the Miller is our designated TIG welder, and operates in both DC and AC, which is necessary for welding aluminum.

OPERATING THE GAS CYLINDERS

1. Open the Argon cylinders, which are always the left-most pair. Do not use Argon/CO2, the right pair, which is for MIG welding.
2. Fully open the the knob valve at the head of the cylinder--do not adjust any other knobs.
3. A separate gas regulator for both Ar and Ar/CO2 is stationed at each welder. Open the lever valve at your station so that the lever is parallel to the pipe, to allow gas to flow to your torch. Make sure you open the correct valve.
4. A smaller knob controls the flow rate of gas. It should always be set between 15-20 FPM, where the ball is floating in this picture. **Do NOT** adjust this valve unless the ball is not floating, or is drastically higher or lower than this range.
5. Finally, with the **Lincoln MP** TIG torch, the torch has a knob for gas to flow. Make sure this is open before you begin welding, and is shut whenever you are not actively welding.

OPERATING THE TORCH

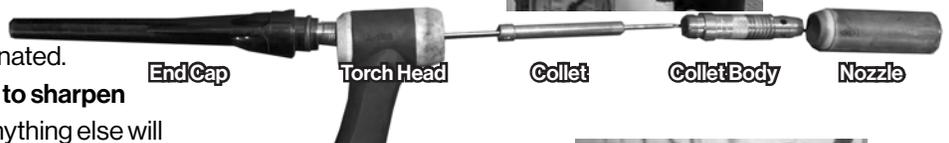
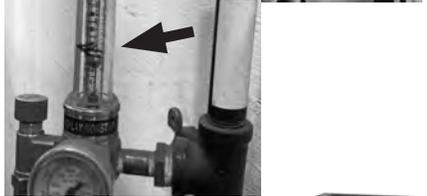
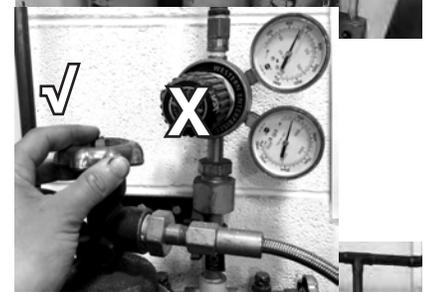
- The torch holds the electrode, a **tungsten** rod which channels the current required to establish an arc. Tungsten must be kept clean and sharpened to a point to stabilize the arc and prevent weld contamination.
- The tungsten comes different sizes. 3/32" is used most often for 14 gauge to 1/4" metals, while 1/16" is used for thinner material like sheet metal.
- The tungsten is held inside the torch by a **collet**. The **nozzle** directs the flow of shielding gas and comes in a variety of sizes. It screws onto the **collet body**, which screws into the **torch head**. The **end cap** covers the end of the electrode and also can come in different lengths. All torch components are stored in the red cabinet outside the welding area.

TUNGSTEN PREPARATION

- Sharpen the tungsten every time it gets contaminated.
- **Only use the bench grinder in the welding area to sharpen tungsten rods.** Using the same wheel to grind anything else will also contaminate the stone and your weld.
- Sharpen as shown in the picture, with the tip sharpening upwards. Try to achieve a 30° tapered point. **Be courteous to others and always leave a sharp tungsten when you're done welding. Do not leave it balled up in the torch for someone to clean up after you!**

MATERIAL PREPARATION

Metal must be smooth and clean for TIG welding. If the metal is clean to start, it will be easier to weld. To clean, grind off any mill scale (using the sanders or angle grinder), bevel the weld joints, and wipe with Acetone (not provided). The welding supplies cart has two types of wire brushes which can also be used to clean metal: stainless steel brushes are for aluminum, and mild steel brushes for steel. **Do not cross-contaminate the brushes!**





FILLER ROD

Open Works provides aluminum and steel filler rods for TIG welding. They are each available in 1/16", 1/32", and 1/8" diameter.

- When selecting filler rod, the filler material should be the same metal as your workpiece (with some exceptions). The diameter filler rod can be as little as 1/2 the thickness, **up to** the same thickness, as your metal. Do not use filler rod that is thicker than your workpiece.
- Hold the rod with a loose grip and thin gloves for more control, so you can continuously feed the rod into the puddle. It helps to cut the rod in 1/2 to keep it from wobbling.
- Feed the filler rod at a 10° angle to your workpiece.
- Use a slight in and out motion for the filler rod, and dip into the leading edge of the puddle.
- Make sure the filler rod isn't too close to the tungsten tip to start, as it may pull the arc away from the base metal.

TIPS FOR WELDING

Pay attention to how you hold the torch. Maintain a consistent **work angle** and a **push travel angle**. Keep the tungsten as close to your puddle as possible without dipping into it.

- For welding flat, maintain a 90° work angle: Looking at the torch in profile, it should appear to be perpendicular to the **puddle** you will form-sometimes you will need to be 45° to the joint you are welding in order to achieve this.
- The push travel angle is the position at which you "push" the bead along, instead of pulling away. The push angle usually ranges from 10-20° for flat work.
- Hold the torch with a loose grip--keep your hand relaxed to move it forward smoothly.
- Postflow is important to protect your weld from contaminating. Hold the torch in position at an end of the weld, for about 10 seconds.

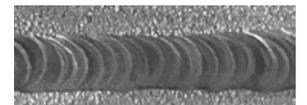
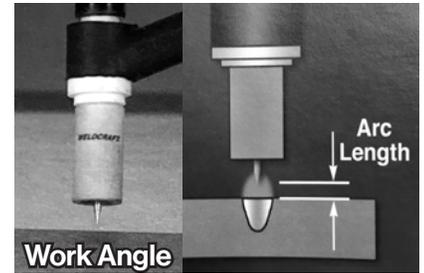
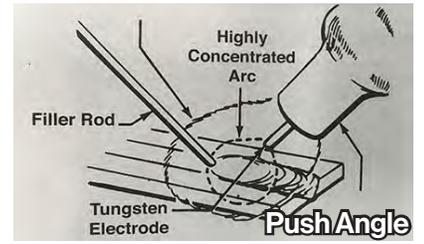
OPERATING THE LINCOLN MP210 FOR TIG WELDING

1. Plug the ground clamp into the positive port (+), where the MIG gun would be plugged in.
2. The TIG torch plugs into the negative port (-). Make sure to twist the plug to lock it in.
3. A pedal allows you to control the amperage, and assists in starting the arc. To install, open the cover to the wire spool. A multi-pin terminal is located beneath the wire feed rollers. Plug the pedal into this terminal. It's a pain, but you must fully turn the collar of the plug tightly to make sure full contact is made in this terminal.
4. Turn on the machine and hit the house shaped icon to get to the main menu. Use the middle scrolling button to select TIG setting. The machine will walk you through the setup, where each page will have you select the material thickness, tungsten size, and foot pedal. Amperage is automatically determined but a setting guide is located in wire spool cabinet.
5. **Open the valve of the torch.** If the valve to the drop down Argon gas regulator is open, you should here a hiss. The tungsten will be contaminated if the arc starts without argon.
6. Initiate the arc using the "lift arc" method: Get the torch into position, then gently rock it into the workpiece, rock back, press the pedal down, lift very slightly away from the metal, and the arc should start. Be patient and gentle, this may take a few tries at first.

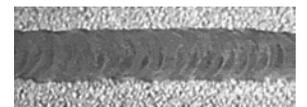
OPERATING THE MILLER SYNCROWAVE FOR DC TIG WELDING

The Syncrowave is our designated TIG welder. AC, DC TIG, DC Stick, and Aluminum MIG are possible. Again, DC mode allows for welding most metals. AC is used for aluminum. Different attachments are necessary for MIG gun and Stick, so ask a technician to set this up for you. This machine has a "High Frequency Start," which starts or stops the arc by simply engaging and disengaging the foot pedal. Only Argon runs to this machine, so DC MIG isn't possible.

1. Turn on the the machine and open up the gas valve behind the welding table.
2. Determine which polarity you are using by simply turning the dial to the setting as shown.
3. Set the amperage using the top dial. There is an amp settings chart inside the machine if you're not sure what to set it to.
4. Experienced welders may change settings by holding the "MENU" button. Parameters including Pulse control, post-flow, AC Balance, tungsten selection can be adjusted. A quick guide of the menu options is also stored inside the machine, but the parameters are left at "PRO-SET," which we recommend especially for beginners.



Dipping Technique (With filler)



Autogenous Technique (No filler)

