



## METAL 3: MIG WELDING

This guide briefly highlights equipment and protocol covered in MIG, Metal 3.

There are many different types of safety hazard produced by MIG welding. The main risks are from electric shock, and inhalation of welding fumes. 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 MIG WELDING?

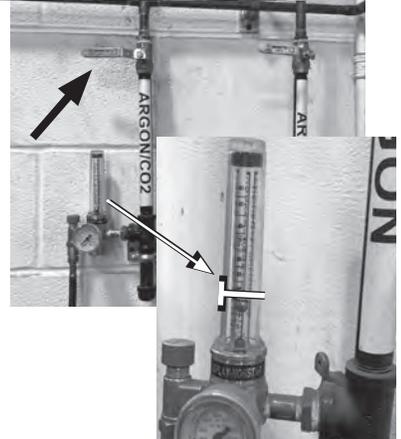
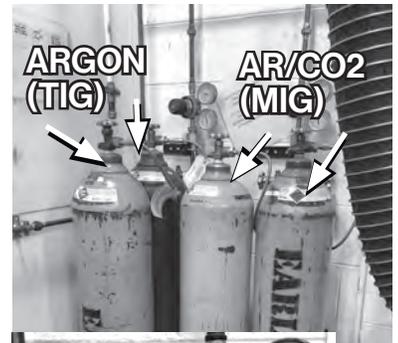
**MIG** stands for Metal Inert Gas. At Open Works, an inert gas mixture of **Argon and CO2** (75% Argon, 25% CO2. This mixture is also referred to as C25.) is used as a shield to create an ideal atmosphere to produce an arc, and protect the weld components from contamination.

A continuous solid wire electrode is fed through a welding gun and into the weld pool, joining the two base materials together. MIG welding is an approachable and strong way to fuse mild steel and create strong connections.

Open Works Lincoln MultiProcess welders have a DC power source, and are set up by default for MIG welding, but can be configured for TIG and Stick welding.

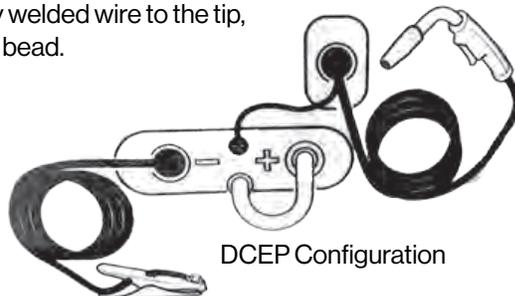
### OPERATING THE GAS CYLINDERS

1. There are two pairs of cylinders: Argon, which is only used for TIG welding, and Argon/CO2, the right pair, which is used for MIG welding. The gas mixture is also labeled on the cylinder. Fully open the the knob valves at the heads of the Argon/CO2 cylinders. Do not adjust any other knobs.
2. 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 gun. Make sure you open the correct valve.
3. 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.
4. You can test the gas flow rate by turning on the machine, going to the MIG settings window, and pressing the trigger of the MIG gun while watching how high the ball floats. Make sure the wire coming from the gun doesn't touch metal while doing this, or it will arc.



### GETTING SET UP

- The wire filler that is fed through the gun, is mounted on a spool inside of the machine. The wire diameter most commonly used at Open Works is .035. Before welding, make sure that there is plenty of wire on the spool and that the spool is clear of tangles and knots.
- Make sure that the machine is set up properly for MIG welding, which is: **Direct Current, Electrode Positive (DCEP)**. Don't worry about what this means, just make sure that the cable for the MIG gun is inserted in the positive port, and the work lead is in the negative port, as pictured in the diagram below. An illustrated poster is stationed below and above each welder to guide you through the setup. Clamp the work lead to something conductive making solid contact with your work (like the table) for good arcing and to minimize risk of electric shock.
- The body of the gun consists of a nozzle and a tip. The wire is fed through the torch tip, and the gas comes out of the nozzle and shields the arc. The tip should be changed when the wire diameter is changed to correspond with the correct diameter. If wire is not emerging, while you're welding or otherwise, it's probably because you've accidentally welded wire to the tip, use the MIG pliers to cut the bead.

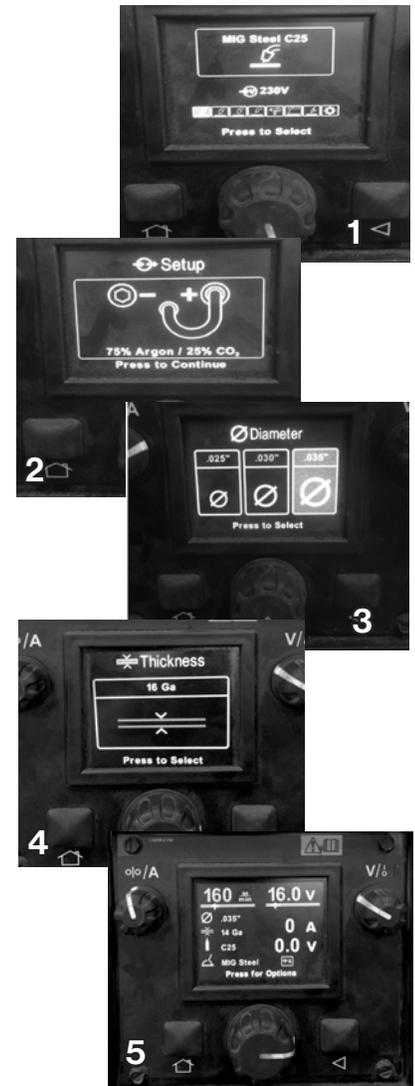




### SETTINGS

The Lincoln MPs provide recommended weld settings based on the material thickness you select. Wire feed rate, in Inches Per Minute, set voltage, travel speed, and distance of arc to workpiece determine the quality of the weld.

1. Turn on the machine and press the Home button. Turn and press the middle scroll wheel down to select MIG Steel C25.
  2. The next screen reminds you of the set up, DCEP. The work lead should be in the “-” port, locked in place by turning slightly. The plug attached to the MIG gun should be in the “+” port.
  3. Choose your diameter wire, which will most likely be .035”.
  4. The following screen will ask you to select the thickness of metal.  
The maximum thickness you can effectively weld is 5/16”.
  5. The final screen allows you to adjust the wire feed rate, the upper dial to the left of the screen, and the voltage, the upper dial to the right of the screen. The range of recommended settings is indicated by a green bar for each. Make minor adjustments and run test welds to see what is most comfortable for you. Record what settings work best for personal records!
- Wire speed controls amperage as well as the amount of weld penetration. The thickness of the welding material will determine the necessary amperage to produce an effective weld. As a guideline, each .001 inch of material thickness requires 1 amp of output:  
**So, if welding steel that is .125” thick will require = 125 amps.**
  - Voltage is a contributing factor to height and width of the bead.  
**For more information, a settings guide is also fixed inside of each welder, under the wire spool cover.**



### PREPARING YOUR MATERIAL

Metal must be clean for MIG 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.

**ACETONE IS A HIGHLY FLAMMABLE LIQUID AND VAPOUR. DO NOT BRING SOLVENTS INTO THE WELDING AREA, AND DO NOT LEAVE CONTAINERS OPEN IN THE SHOP!**

### TIPS FOR WELDING

- Pay attention to how you hold the gun. To avoid welding the electrode to the contact tip, maintain a wire stick-out of 1/4” – 1/2” while running your bead. The amount of stickout and angle of the gun will contribute to the size of the weld.
- Maintain a consistent **work angle** and a **push travel angle**, which may change depending on the type of weld and position in which you weld.
- To start, when welding a butt joint, hold the MIG gun at a 90-degree work angle (in relation to the work piece). Depending on the thickness of the base material, push the gun at a torch angle between 5 and 15 degrees.
- Watch the edges of the molten puddle carefully to learn how to control and maintain well formed, well penetrated welds. When running beads, you can try different “weaving techniques,” moving the electrode in small circles, zigzags, or by “whipping” the gun forward two steps and back a step as you push the weld puddle along. The welds should consist of slightly mounded, evenly spaced and overlapping beads. The edges of the weld should blend into the base metal without undercutting.

