

MIG Welding Training Notes

1 Safety

PPE Requirements:

- A welding helmet (provided by the space)
- Proper welding gauntlets, i.e. not just general purpose gloves (provided by the space)
- Eye protection or a full-face shield, for grinding (provided by the space)
- Long sleeves and good sturdy shoes are highly recommended
- A respirator (FFP3 rated) is highly recommended

Most of the dangers present in welding can be avoided by following general workshop good practice. A few risks specific to welding deserve special mention:

- Burns. Serious burns are rare in welding, because only a small area of the part is ever red-hot at one time. However, small nuisance burns are very common when starting out. The major cause of these is handling parts after welding but before they have fully cooled, a process which can take several minutes.
- Eye damage (arc-eye). This is damage to the eyes caused by exposure to the UV rays in the electric arc - essentially sunburn for the eyes! It's usually temporary but can be permanent in a really bad case. Fortunately, your welding mask will prevent it – so don't forget to wear it.
- Sunburn - just as arc eye is caused by UV rays in the arc, these can burn skin just like the sun can. Fortunately a short session will typically do no harm, but for long sessions consider applying sun cream or even better, covering up any exposed skin.
- Spatter - these are small blobs of molten metal which fly off the weld as it's made. They usually cool down to small pellets by the time they land on you, so are more of a nuisance than an injury risk - but long sleeves will avoid them
- Fire - as welding generates heat, you should be careful not to do it close to flammable materials like paper or wood. Check your area before you start and, importantly, for around 15 minutes after you finish welding – a stray spark or spatter could start a smouldering fire, which takes time to develop.
- Angle grinders, commonly used as part of welding, prevent their own risks. Eye goggles or a full face shield should be worn, and the path of sparks avoided. Never put sideways pressure on a thin angle grinder cutting disc or it may shatter.

2 Welding Theory

The basic principle of welding is simple enough - you get the metal hot, it melts, and it re-solidifies as a single united piece. The notes in here will expand on that principle just enough to give you the information you need to get started - but there's a huge amount more to understand, which you will hopefully learn as the need develops

| | |
|---------------------------------------|------------------|
| W/O: 21032-T001-r02 | DATE: 2022-09-13 |
| TITLE: LHS MIG WELDING TRAINING NOTES | PAGE: 1 OF 4 |

Welding requires three key ingredients:

- A heat source - this could be many things, but on the LHS machines is always an electric arc
- Some metal - in our case, mild steel. As well as the piece or pieces being welded together, most welding processes also add some additional material to fill in the gap, which is called a 'filler'
- Some form of flux or shielding. This is a substance which is added to temporarily protect the molten metal during the melting and cooling process, removing impurities, and preventing it reacting with oxygen in the air

3 Types of Welder

Hackspace has three types of welding machine – stick, MIG and TIG. This induction is focused on the MIG machine, but it's worth a quick description of the others so you can see how it all fits together.

An MMA or 'stick' welder. This is probably the simplest of all electric welders. To use it, a rod of filler metal called an electrode is placed into a torch handle and touched onto the work until an arc is generated. This melts the rod which flows in and forms the joint, so the handle is moved steadily closer to the work and the weld continued until it is all used up. The rods are coated with a flux compound, which provides protection and is scraped off afterwards. These welders are cheap to buy and to run, and teach a lot about arc control, but are not widely used in factory production any more as they are slower and harder to control than other processes. They are however widely used when welding outdoors, because the solid flux used does not blow away in the wind like the gasses used in MIG and TIG

The MIG welder. This is a great all-rounder and quite easy to learn to use. Unlike the stick welder, the filler metal is applied as a wire which is automatically fed through the handle when the trigger is pulled. Instead of solid flux, the handle also jets a cloud of gas which provides the function of shielding the molten metal. In this way fast, neat welds can be produced with relatively little skill, so these machines are at the heart of the modern fab-shop. The MIG process can be used with most materials, but ours at LHS is limited to steel

The TIG welder has some common features with the MIG, mostly that the shielding is provided by a gas jetted out from the torch. However, the torch of the TIG machine is not fitted with any filler metal. Instead it contains a tungsten electrode, which is capable of creating the electric arc without actually melting at all. Used this way, the torch only provides the heat and the shielding - the filler metal is added separately from a plain metal rod held in the opposite hand. This means that the supply of heat and the supply of filler metal are separate and the operator is in complete control of both as they are welding. This gives the operator maximum control, particularly useful for delicate pieces such as thin sheet metal. it's also easy to reconfigure the welder for different materials, like aluminium or stainless steel. The only real downside of TIG is that it requires a lot of skill to master, and even then is still slower than other processes

4 A Short Aside – Angle Grinders

The angle grinder is a very useful tool across many branches of metalwork, welding definitely among them. Specifically, it is good at cleaning parts down to a bare metal surface before welding, and then for cleaning up welded parts afterwards. (And also for 'unwelding' a badly made or incorrectly placed weld...)

The LHS grinders don't require training, but your welding trainer will gladly provide an introduction at this stage if you are unsure. For the majority of this training, you will need one fitted with a grinding disc

| | |
|---------------------------------------|------------------|
| W/O: 21032-T001-r02 | DATE: 2022-09-13 |
| TITLE: LHS MIG WELDING TRAINING NOTES | PAGE: 2 OF 4 |

5 MIG Machine Basic Setup

The normal process of setting up the LHS MIG is:

- 1) Roll it out into the cage (only the TIG can be used indoors) along with the required PPE, and any other tools you may need - typically a pair of pliers for the wire, clamps, grinder, files etc
- 2) Close the red welding curtain, to protect passers-by from the arc flashes
- 3) Connect the power socket to the blue 16A supply and turn on the welder
- 4) Attach the earth clamp. This part provides the 'closed circuit' for the electricity to travel through, so it's important for it to be a good electrical contact with the work. The attachment point must be clean metal, and preferably close to the weld location - although sometimes it's convenient to simply attach it to the workbench, provided the workpiece is also firmly contacting the clean bench
- 5) Turn on the gas - this is done first by opening the valve on the side of the canister, and then by setting a gas flow rate via the regulator. If you don't have a reason to vary it, a figure of **20 cubic feet per hour (20cfh)** is a good all-rounder on this machine
- 6) (for best results) clean your workpieces to bare metal in the zone you want to weld, arrange them ready for welding
- 7) Check that the wire feed is operating correctly (see next section) and then start welding

6 MIG Machine Wire Feed Maintenance

The LHS MIG machine should always be left in a functional state such that you can pick it up and start welding as soon as you come in. But sometimes you might find it isn't, or a problem might develop as you are working – so you need to be prepared to carry out a basic torch strip down and wire re-feed.

The torch consists of an outer shroud to funnel the gas and an inner nozzle to feed the wire. Both are consumable parts but will last a very long time before replacement is required. It is mostly useful to know how to remove them in case of a wire jam

If a wire jam does occur, you will need to break off any excess at the tip and re-feed from inside the machine. The demonstrator will show all of this in practice

7 Welding Settings

Most of the skill in MIG welding is knowing how to set the voltage and wire feed settings, but it's very difficult to explain in simple terms as there are many variables, the best way to learn is through practice. In essence, lower numbers (on both dials) are best suited to thinner, more fragile workpieces whereas thick plates will require higher settings. As a rule of thumb, this manufacturer recommends a **wire feed 4 units higher than the voltage** for 'typical' welding conditions.

| | |
|---------------------------------------|------------------|
| W/O: 21032-T001-r02 | DATE: 2022-09-13 |
| TITLE: LHS MIG WELDING TRAINING NOTES | PAGE: 3 OF 4 |

8 Practice

At this point, you will grab some scrap metal and practice. The first technique we will cover is simply 'laying a bead' of weld onto a piece of scrap metal, without attempting to make an actual joint at this stage. Get used to seeing and navigating with the helmet on, and how difficult it can be to stay in a straight line. Try different combinations of welder settings, hand travel speeds, and torch positions (push/ drag). Try and write your name/ initials

Next we will attempt a fillet weld. Take two pieces, and position at right angles. We will first 'tack' weld them into place. 'tacks' are one or more small welds positioned around a part to lock it in position before the welding begins properly. This helps everything stay in position - as you'll quickly find, cooling welds shrink considerably and they can introduce large distortions into a part. Then, weld it up from end to end, turn round and do the other side

9 Packing Away

Packing away the welding gear is relatively simple, but must be done carefully to ensure the welder and the workstation are in a fit state for others to use. **THE MOST IMPORTANT THING IS TO SHUT OFF THE GAS**

- Shut off the Gas from the regulator by unscrewing the black flowrate adjusting knob
- Shut off the Gas from the bottle by tightening the square keyed valve TIGHTLY
- Unplug the welder and coil up the power, earth clamp and torch leads on top of the machine
- Roll the machine back indoors and put it next to the TIG bench
- Return any accessories (PPE, grinders etc) to their homes
- Throw away any scrap metal and brush down the workbench

10 Revision History

| Rev No | Date | Description |
|--------|------------|----------------------------------|
| r01 | 2022-08-31 | First Release |
| r02 | 2022-09-13 | Respirator PPE Requirement Added |

| | |
|---------------------------------------|------------------|
| W/O: 21032-T001-r02 | DATE: 2022-09-13 |
| TITLE: LHS MIG WELDING TRAINING NOTES | PAGE: 4 OF 4 |