GUIDE TO BASIC MIG WELDING

This document was modified from http://www.r-techwelding.co.uk

1. WHAT IS MIG WELDING?

MIG welding was developed in the 1940's and 60 years later the general principle is still very much the same. MIG welding uses an arc of electricity to create a short circuit between a continuously fed anode (+ the wire-fed welding torch) and a cathode (- the metal being welded). The heat produced by the short circuit, along with a non-reactive inert gas locally melts the metal and allows them to mix together. Once the heat is removed, the metal begins to cool and solidify, and forms a new piece of fused metal. MIG welding is useful because you can use it to weld many different types of metals: carbon steel, stainless steel, aluminum, magnesium, copper, nickel, silicon bronze and other alloys.

Advantages to MIG welding:

- The ability to join a wide range of metals and thicknesses
- All-position welding capability
- A good weld bead
- A minimum of weld splatter
- Easy to learn

Disadvantages of MIG welding:

- MIG welding can only be used on thin to medium thick metals
- The use of an inert gas makes this type of welding less portable than arc welding which requires no external source of shielding gas
- Produces a less controlled weld as compared to TIG (Tungsten Inert Gas Welding)

2. HOW DOES THE MIG WELDER WORK?

A MIG Welder has a couple of different parts. If you open one up you will be able to see something like the pictures below

The Welder
Inside the welder you will find a spool of wire and a series of rollers that pushes the wire out to the welding torch. There isn't much going on inside this part of the welder, so it's worth it to take just a minute and familiarize yourself with the different parts. If the wire feed jams up for any reason you will want to check this part of the machine out. The large spool of wire should be held on with a tension nut. The nut should be tight enough to keep the spool from unraveling so to avoids over-run (birds nesting) when trigger released, but not so tight that the rollers can't pull the wire from the spool. If you follow the wire from the spool you can see that it goes into a set of rollers that pull the wire off of the big roll, this then pushes the wire up to the torch to the tip ready for welding.

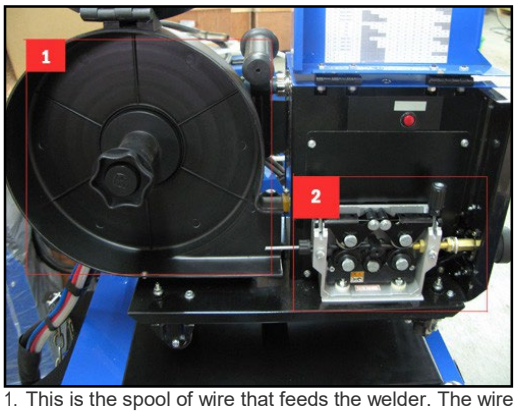
The Gas Supply
Assuming you are using a shielding gas with your MIG welder there will be a cylinder of gas behind the MIG. This is either 100% Argon or a mixture of CO2 and Argon. This gas shields the weld as it forms. Without the gas your welds will look brown, splattered and just generally not very nice. Open the main valve of the cylinder and make sure that there is some gas in it. Your gauges should be reading between 0 and 2500 PSI in the tank and the regulator should be set between 15 and 25 PSI depending on how you like to set things up and the type of welding torch you are using. When welding in areas with a draught you may need to run more gas pressure to avoid getting porosity in the weld.

Once the wire passes through the rollers it is pushed down a set of hoses which lead to the welding torch. The hoses carry the charged electrode and the argon gas.

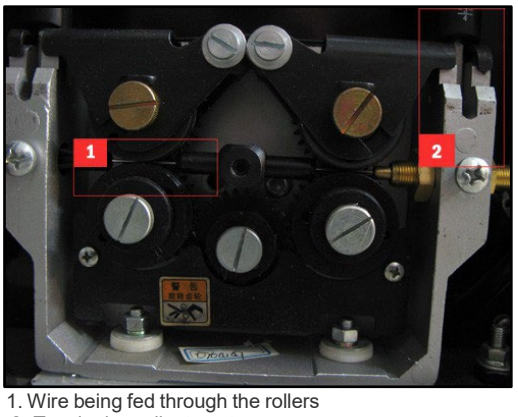
The Welding Torch
The welding torch is where most of your attention will be directed during the welding process. The torch consists of a trigger that controls the wire feed and the flow of electricity. The wire is guided by a replaceable copper tip that is made for each specific welder. Tips vary in size to fit whatever diameter wire you happen to be welding with. Most likely this part of the welder will already be set up for you. The outside of the tip of torch is covered by a metal shroud which protects the electrode and directs the flow of gas out the tip of the torch.

The Ground Clamp
The earth clamp is the cathode (-) in the circuit and completes the circuit between the welder, the welding torch and the project. It should either be clipped directly to the piece of metal being welding or onto a metal welding table like the one pictured below.

The earth clamp must be making good contact with the piece being welded for it to work so be sure to grind off any rust or paint that may be preventing it from making a connection with your work.

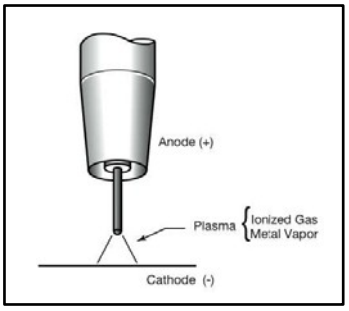


1. This is the spool of wire that feeds the welder. The wire comes off the spool, is pushed through the feeder and travels out to the welding torch.
2. These are the rollers that pull the wire off the spool and send it out to the welding torch



1. Wire being fed through the rollers
2. Tensioning adjustment


Clamp the negative lead from the welder onto your project or, in this case, the welding table



3. SAFTEY GEAR

MIG welding can be a pretty safe thing to do so long as you follow a few important safety precautions. Because of MIG welding produces lots of heat and lots of harmful light, you need to take a few steps to protect yourself.

- Wear all natural fiber clothing. This is because synthetic materials melt when exposed to intense heat and increase the risk of burns. Synthetic clothing is less safe and seen as a safety risk. In the case of injury of a burn, synthetic materials can pose a hazard and complications to wound healing.

- You must wear clothes toed shoes / work boots. Do not wear open toed shoes or synthetic shoes that have mesh over the top of your toes. Hot metal and sparks often falls straight down. This is especially true if you are using a plasma cutter or oxy-acetylene cutting tip.

- Wear gloves and leathers to protect yourself from molten metal splattering off of your work piece. Some people like thin gloves for welding so you can have a lot of control. The leathers will not only protect your skin from the heat produced by welding but they will also protect your skin from the UV light produced by welding. If you are going to be doing any amount of welding more than just a minute or two you will want to cover up because UV burns happen fast and over a long period of time unprotected skin can cause cancer.

- The light that is generated by any form of arc welding is extremely bright. It will burn your eyes and your skin just like the sun will if you don't protect yourself. The first thing you will need to weld is a welding mask. Think of protecting others from the light as well and use a welding screen if it's available to make a border around your workspace.

- Weld in a well ventilated area. Welding produces hazardous fumes which you shouldn't breathe in if you can avoid it. Wear either a mask, or a respirator if you are going to be welding for a prolonged amount of time.

Important Safety Warning
DO NOT WELD GALVANIZED STEEL. Galvanized steel contains a zinc coating that produces carcinogenic and poisonous gas when it is burned. Exposure to the stuff can result in heavy metal poisoning (welding shivers) - flu like symptoms that can persist for a few days, but that can also cause permanent damage.

Fire and First Aid
Molten metal can spit several feet from a weld. Grinding sparks are even worse. Any sawdust, paper or plastic bags in the area can smolder and catch fire, so keep a tidy area for welding. Your attention will be focused on welding and it can be hard to see what's going on around you if something catches fire. Reduce the chance of that happening by clearing away all flammable objects from your weld area.

Know where a fire extinguisher is located, eyewash stations and first aid kits. CO2 is the best type for welding. Water extinguishers are not a good idea in a welding shop since you are standing next to a whole lot of electricity.

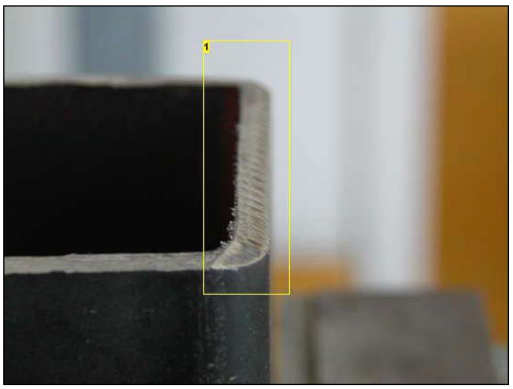
Gloves, auto-darkening helmet and a suitable cotton based jacket are essential to keep safe

4. PREPARING FOR THE WELD

Before you start welding make sure things are properly setup at both the welder and on the piece you are about to weld.

The Welder
Check to make sure that the valve to the shielding gas is open and that you have around 14LPM flowing through the regulator. The welder needs to be turned on, ground clamp attached to your welding table or to the metal directly and you need to have the right combination of welding power and wire feed speed

The Metal
While you can pretty much just take a MIG welder, squeeze the trigger and touch it to your work piece to weld you won't get a great result. If you want the weld to be strong and clean, taking 5 minutes to clean your metal and grind down any edges thicker than 1/16 of an inch that are being joined to have a bevel. By creating two bevels on the joining edges it makes a little valley for the weld pool to form in. Doing this for butt welds (when two things are pushed together and joined) is a good idea.



1.Bevel the edge on your metal before welding

5. LAYING A BEAD

Once your welder is set up and you have prepped your piece of metal it's time to start focusing on the actual welding. If it's your first time welding you might want to practice just running a bead before actually welding two pieces of metal together. You can do this by taking a piece of scrap metal and making a weld in a straight line on its surface.

Do this a couple of times before you start actually welding so that you can get a feel for the process and figure out what wire speed and power settings you will want to use.Every welder is different so you will have to figure these settings out yourself. Too little power and you will have a splattered weld that won't penetrate through your work piece. Too much power and you might melt right through the metal entirely.

The pictures below show a few different beads being laid down on some 1/4" plate. Some have too much power and some could use a little more. See the image notes for the details. The basic process of laying a bead is not too difficult. You are trying to make a small zig zag with the tip of the welder, or little concentric circles moving your way from the top of the weld downward. I like to think of it as "sewing" motion where I use the tip of the welding torch to weave the two pieces of metal together.

First start laying beads about an inch or two long. If you make any one weld too long your work piece will heat up in that area and could become warped or compromised, so it's best to do a little welding in one spot, move to another, and then come back to finish up what's left in between.

What are the right settings?
If you are experiencing holes in your work than your power is turned up too high and you are melting through your welds.

If your welds are forming in spurts your wire speed or power settings are too low. The torch is feeding wire out of the tip, it's then making contact, and then melting and splattering without forming a proper weld.

You'll know when you have settings right because your welds will start looking nice and smooth. You can also tell a fair amount about the quality of the weld by the way it sounds. You want to hear continuous sparking. Some welders says it sounds like an egg frying!

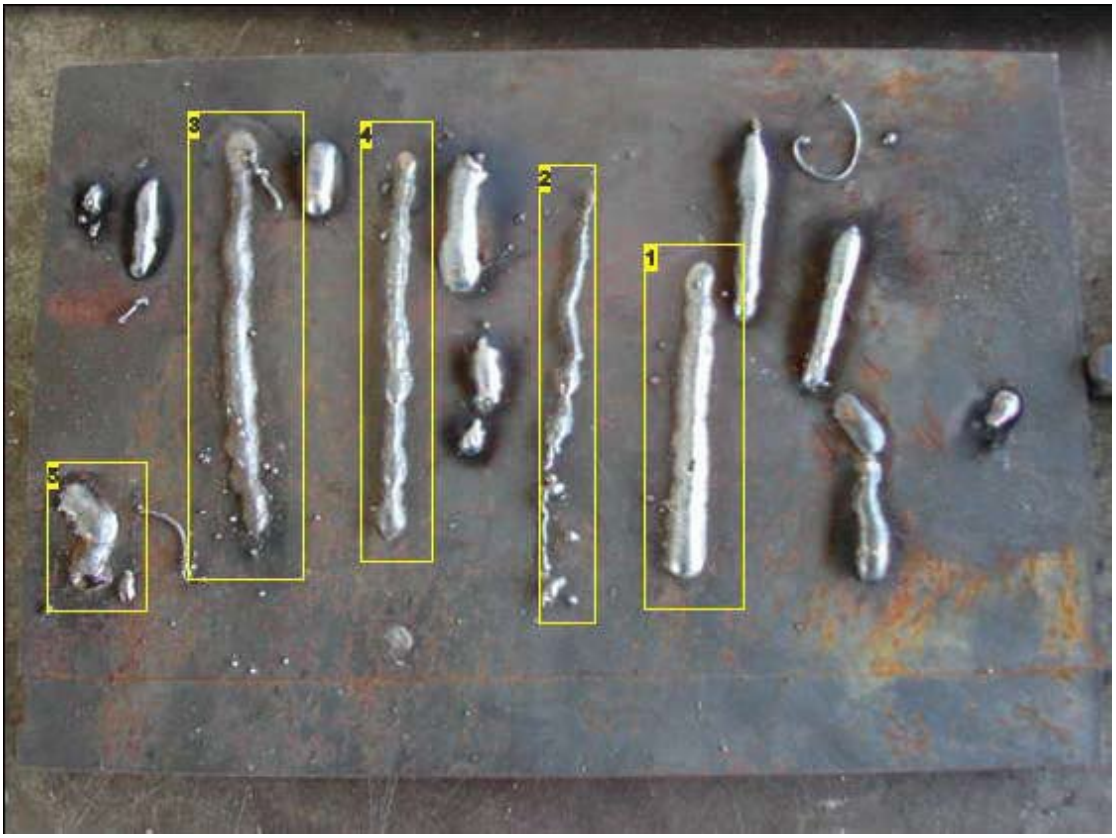


Image Notes
1. These settings are pretty good.
2. Not enough power, not enough wire feed.
3. Good wire feed, not enough power.
4. Good wire feed, not enough power.
5. It takes a little while to get comfortable, don't be afraid to make some test welds to get a feel for it.

Image Notes
1. These are similar power and feed settings, but tested on a much thinner sheet of steel plate. As you can see the weld has penetrated very deeply and is starting to deform the piece. You can see some curling on the sides of the plate.

Image Notes
1. Too much power has created a burn hole in the metal

6. COMMON PROBLEMS

It can take a good amount of practice to start welding reliably every time, so don't worry if you have some problems when you first stop. Some common problems are:

- No or not enough shielding gas from the torch is surrounding the weld. You can tell when this happens because the weld will start splattering little balls of metal, and will turn nasty colors of brown and green you can also see air bubbles on top of the weld (porosity). Turn up the pressure on the gas and see if that helps.
- Weld is not penetrating. This is easy to tell as your weld will be weak and won't be fully joining your two piece of metal. Try more power and wire speed.
- Weld burns a while right through your material. This is caused by welding with too much power. Simply turn down your welding power and it should go away.
- Too much metal in your weld pool or the weld is sloppy like porridge. This is caused by too much wire coming out of the torch and can be fixed by slowing down your wire speed.
- Poor weld penetration, erratic weld. Check condition of earth clamp and ensure where it fits to bench is clean and free from rust / paint. If earth clamp shows signs of overheating fit new clamp or complete lead assy
- Welding torch spits and does not maintain a constant weld. This could be caused because the torch is too far from the weld.
- You want to hold the tip of the torch about 1/4" to 1/2" away from the weld.