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## MIG vs. Flux-Cored: Which Welding Process Is Right for You?

You are about to make the plunge and buy your first wirefeed welder. Being a toolguy (or gal), you don't want to waste your money on a toy that goes out with the trash in a few weeks. You most likely are very comfortable building things from wood, but you always wanted to step up to steel. You probably want to run it off of 115 volt input, so that it is very portable, but maybe stepping up to the 230 volt input machines with the option of welding thicker material (more than 1/4") is a valid point. You think the decision-making process is over when you are hit with yet another question - which welding process will you use? . . . GMAW (MIG) or FCAW (flux-cored)? If you are like most novice welding operators, you may be confused as to the differences of these two choices. The best answer depends on 3 things. First, what you are welding. Second, where are you welding it. And Third, the surface finish of what you are welding. We will help you to decipher between the two processes, then describe advantages and disadvantages of each and wrap up by giving you usage tips. Ultimately, we hope to help you decide on a solution that will give you the best results for your application. The suggestions here are conservative and should be attainable by a beginner. Welding is a skill and an art about 95% can learn to do. Very few baseball players are able to hit over .350 in the majors. Very few welders have the skills to make picture perfect welds. It is critical to have good eye/hand coordination and a steady hand. Arc practice time is the only instructor that will teach you to truly set the machine properly. With basic motor skills, practice and patience, you should attain success at making sound welds.



### The Definitions

#### Gas Metal-Arc Welding:

(**GMAW**) as identified by the American Welding Society, is also popularly known as MIG (Metal Inert Gas) and uses a continuous solid

wire electrode for filler metal and an externally supplied gas (typically from a high-pressure cylinder) for shielding. The wire is usually mild steel, typically copper colored because it is electroplated with a thin layer of copper to protect it from rusting, improve electrical conductivity, increase contact tip life and generally improve arc performance. The welder must be setup for DC positive polarity. The shielding gas, which is usually carbon dioxide or mixtures of carbon dioxide and argon, protects the molten metal from reacting with the atmosphere. Shielding gas flows through the gun and cable assembly and out the gun nozzle with the welding wire to shield and protect the molten weld pool. Molten metal is very reactive to oxygen, nitrogen and hydrogen from the atmosphere, if exposed to it. The inert gas usually continues to flow for some time after welding to keep protecting the metal as it cools. A slight breeze can blow the shielding away and cause porosity, therefore welding outdoors is usually avoided unless special windscreens are erected.

However, if done properly, operator appeal and weld appearance are excellent with MIG and it is most welders' favorite process to use. Good technique will yield excellent results. The properly made finished weld has no slag and virtually no spatter. A "push" gun angle is normally used to enhance gas coverage and get the best results. If the material you are welding is dirty, rusty, or painted it must be cleaned by grinding until you see shiny bare metal. MIG welding may be used with all of the major commercial metals, including low carbon steel, low alloy steel, and stainless steel and aluminum with potential for excellent success by a novice.

### **Aluminum MIG**

Welding aluminum requires much more than just changing to aluminum wire. Get comfortable welding steel first. Since aluminum is very soft, it requires aluminum drive rolls that have a U-groove and no teeth to bite or cause wire flaking. Cleanliness of the wire and base metal are critical. Wipe the material with acetone on a clean shop rag. Use stainless steel wire brushes that have only been used on aluminum. Drive roll tension and gun length must be minimized. A Teflon, nylon or similar gun liner is needed to minimize friction in feeding the wire and 100% pure Argon gas is required for shielding. Special contact tips are often recommended. Special gun movement techniques are often highly desirable. It is a challenge, but it can be done.

### **Self-shielded Flux-Cored Arc-Welding process**

(**FCAW** per the American Welding Society), or flux-cored for short, is different in that it uses a wire which contains materials in its core that, when burned by the heat of the arc, produce shielding gases and fluxing agents to help produce a sound weld, without need for the external shielding gas. We achieve a sound weld, but in a very different way. We have internal shielding instead of external shielding. The shielding is very positive and can endure a strong breeze. The arc is forceful, but has spatter. When finished, the weld is covered with a slag that usually needs to be removed. A "drag" angle for the gun is specified which improves operator visibility. The settings on the

wirefeeder / power source are slightly more critical for this process. Improper technique will have results that are magnified. This type of welding is primarily performed on mild steel applications outdoors. The [Innershield® .035" NR®-211MP](#) is often used for the 115 volt machines and the [.045" Innershield NR-211MP](#) is typically used in the 230 volt machines. Farmers have found that these products can save a planting or harvest by repairing a broken machine out in the middle of the field in record time.

## General Usage Rules

### MIG

As a rule of thumb, it is recommended to use a compact 115volt input (or 230 volt) MIG wirefeeder/welder indoors on clean new steel that is 24 to 12 gauge thick. 12 gauge is a little less than 1/8" thick. 24 gauge is less than 1/16" thick. The smallest wire(.025") will make it the easiest to weld the thinnest(24 gauge) material. The .030" diameter wire will weld a little faster deposition rate. If you need to weld 1/8" to 1/4" thick material with MIG, you will need the higher capacity compact machine which will require 230 volt input. The higher amperage range of this machine can better handle your welding needs in a single pass and you may not have to waste time with second or third passes. The 230 volt machine could also run .035" diameter wire. To MIG weld material more than 1/4" thick, you need a higher capacity truly industrial machine. If most of your welding will be performed indoors on clean material that is less than 1/8" thick, a MIG machine that operates on 115 volts is probably your best bet for economic reasons in that a 230 volt input machine will be more expensive.



### Flux-Cored

The flux-cored process is only recommended on materials as thin as 20 gauge, a bit thicker than the 24 gauge we said for MIG. In general, this process is best for welding thicker materials with a single pass, especially if you need to weld outdoors such as to repair a tractor out in the field. A 115 volt flux-cored machine using an electrode such as .035" Innershield NR-211-MP will generally allow you to weld steel up to 1/4"thick. Note that this is more than double the thickness maximum of 12 gauge with MIG on 115 volts. With the proper electrode on a proper machine, such as .045" Innershield NR-211MP, and a 230 volt input machine, you can weld steel up to 1/2" thick. Note that NR-211MP



requires that the machine be setup for DC negative polarity.

### **Advantages/Disadvantages**

While there are advantages and disadvantages to both processes, we will try to outline for you some of the most common.

### **MIG**

#### ***Advantages***

- The best choice when cosmetic appearance is an issue since it provides lower spatter levels than flux-cored. The arc is soft and less likely to burn through thin material.
- The lower spatter associated with MIG also means no slag to chip off and faster cleaning time.
- MIG is the easiest type of welding to learn and is more forgiving if the operator is somewhat erratic in holding arc length or providing a steady travel speed. Procedure settings are more forgiving.
- If you are skilled and get specific proper guns, shielding gas, liners, drive rolls, and electrode, MIG can weld a wider range of material including thinner materials and different materials such as stainless, nickel alloys or aluminum.



#### ***Disadvantages***

- Since a bottle of external shielding gas is required, MIG may not be the process of choice if you are looking for something that offers portability and convenience. MIG also requires additional equipment such as a hose, regulator, solenoid (electric valve) in the wire feeder and flowmeter.
- The welder's first job is to prepare the surface by removing paint, rust and any surface contamination.
- MIG has a soft arc which will not properly weld thicker materials (10 gauge would be the maximum thickness that MIG could soundly weld with the 115 volt compact wirefeed welders we are referring to or ¼" with the 230 volt input compact wirefeed machine.) As the thickness of the material (steel) increases, the risk of cold lapping also increases because the heat input needed for good fusion is just not possible with these small machines.

### **Flux-Cored**

#### ***Advantages***

- The Self-Shielded electrodes are optimal for outdoor procedures since the flux is built into the

wire for positive shielding even in windy conditions. An external shielding gas and additional equipment are not needed, so setting up is simpler, faster and easier.

- The flux-cored process is most suited for applications with thicker materials as it is less prone to cold lapping.



### **Disadvantages**

- It is not recommended for very thin materials (less than 20 gauge).
- When flux-cored welding, machine settings need to be precise. A slight change in a knob position can make a big difference in the arc. In addition, the gun position is more critical in that it must be held consistently, and at the proper angle, to create a good weld.
- This process creates spatter and slag that may need to be cleaned for painting or finishing.

It should be noted that the same machine can be used to weld with both MIG and flux-cored processes though a special package is usually needed to change from one application to the other. Drive rolls, shielding gas, gun liners and contact tips and procedure settings need to be addressed when changing processes.

### **Choosing Wire**

Another area that may cause the novice welder some concern is how to choose the best wire. Proper electrode diameter is related to plate thickness and the welder you have. A smaller wire makes it easier to weld thinner plate.

For a 110 volt input MIG machine, an electrode such as [Lincoln's .025" SuperArc® L-56™](#) is the smallest available size and the easiest to use on very thin material. A .030" SuperArc would weld slightly thicker material a little faster. For flux-cored, a 110v machine would run a .035" wire (such as Lincoln's NR-211-MP) because this is the smallest size made and this is all the machine can run.

For a 230v MIG machine, most people are welding heavier plate and step up to the .030" or even .035" diameter solid electrode such as .030" or .035" Super Arc L-56 because they deposit weld metal faster and they can weld heavier plate. For flux-cored with the 230 volt input machine, most people move up to Lincoln's .045" diameter Innershield NR-211MP for plate up to ½" thick.

Realize that these small machines are excellent at what they do, but they cannot do everything. Electrodes for production welding, hardfacing to resist wear, and most specialty electrodes will exceed the capacity of these machines. You must be careful to match the output

voltage of your machine with the voltage of the electrode and the appropriate wire diameter and wire feed speeds to make sure you have a compatible system.

### **Tips for All**

1) It is very important to get a good, solid work connection. This means you should thoroughly clean or grind the surface of the metal where attaching the work clamp and use a tightly attached work clamp so electricity can easily flow through the workpiece and back to the welder. Paint and rust are insulators. Remove them. This is a very common mistake to overlook.

2) Put the welder on a separate circuit breaker that is properly fused as stated in your Operators Manual. This is not another strand of Christmas lights. You are melting steel at around 5,000 degrees F. You cannot weld with inadequate input power. Don't even try.

3) Good fitup is a big plus. Weld joints are laps, fillets and butts. Avoid gaps whenever possible to minimize burnthrough problems. This is especially critical on thin sheet metal.

4) Keep the gun cable as straight as possible for smooth wire feeding. Don't sharply bend it.

5) Make sure the contact tip looks good(not elongated or melted) and it is tightened to the diffuser.

6) Cut the wire at an angle to a point before starting to weld for better starts.

7) Use correct electrode stickout and maintain it as well as proper welding procedures.

8) Make sure the driverolls feed smoothly with proper tension.

9) Relax and try to hold the gun as steady and smooth as possible.

10) Make sure you observe and follow all welding safety precautions as specified in your Operators Manual. Pay special attention to the potential for electric shock, arc rays that can burn skin and eyes, fire and explosion, and proper ventilation. For more details, consult ANSI Z 49.1.

Happy Welding.

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