

Understanding the Basics of Metal-Cored Wire

In the right welding applications, metal-cored wire can minimize costs, improve quality and increase productivity. Like any filler metal, it has unique characteristics, benefits, limitations and applications where it works best. Knowing when and how to use metal-cored wire can help you achieve success.

The technology and applications

Metal-cored wire is a tubular wire filled with metallic powders, small amounts of arc stabilizers that provide specific benefits. These include wider penetration profiles, higher tolerance to dirty or hot-rolled base metal and fewer silicon islands in the final weld. Metal-cored wire offers higher deposition rates than solid wire for a given heat input. Metal-core wire does not produce slag like flux-cored wires do. The lack of slag makes metal-cored wire more efficient, because more wire deposits in the joint as weld metal. No slag also reduces interpass and post-weld cleaning.

Metal-cored wire is easily alloyed and available in many different chemistries, so you can weld with it on a range of base metals. You can use metal-cored wire in many of the same applications as solid wire, but it excels for welds that are six inches or longer, in flat or horizontal position using spray or pulsed gas metal arc welding (GMAW) transfer. Spray transfer maximizes the benefits of metal-cored wire in two key ways: 1) You can weld faster. 2) It generates little to no spatter, so you can reduce post-weld cleanup. Other applications well suited to metal-cored wire include: those prone to burn-through; components presenting poor fit-up; and jobs where aesthetics are important.

Benefits of metal-cored wire

The combination of metal-cored wire's tubular structure and the use of spray transfer creates a broad, cone-shaped arc and a wide penetration profile. This arc shape generates a consistent bead profile that bridges gaps easily and accurately without burn-through. Other key benefits of metal-cored wire include:

- It produces smaller droplets of liquid metal across the arc, which reduces turbulence in the weld pool.
- It offers fast travel speeds and high deposition rates (compared to solid wire), so you can increase productivity.
- It can minimize weld defects like lack of fusion and undercut, allowing you to reduce rework.
- It can weld through mill scale and rust and still produce very little spatter, which reduces the need for pre-weld grinding, sand blasting or applying anti-spatter compound.

Cost factors to consider

Metal-cored

wire is more expensive per unit than solid wire. You'll need to consider whether your application can offset that extra cost by making your welding operation more efficient. If you weld often in short circuit mode, out of position or for a low percentage of time, metal-cored wire may not be the most cost effective. Metal-cored wire is most productive welding in position for longer periods of time and provides the best long-term savings here.

Consider the pros and cons of shielding gas, too. You need high levels of argon (90 percent argon/10 percent CO₂ or 75 to 95 percent argon with the remainder CO₂) to gain the most benefits from metal-cored wire in spray transfer mode. Argon is a more expensive gas, so decide if your productivity and quality gains will reduce costs. Work with a trusted welding distributor or filler metal manufacturer to conduct a time trial to determine your potential savings.

Keep in mind, too, that welding is only one step in the production process. If you increase productivity with metal-cored wire, can your post-weld operations like painting keep up? That is important to realizing overall cost savings.

Tips and techniques

Welding with metal-cored wire is similar to welding with solid wire, with a few exceptions.

- **Use V-knurled drive rolls.** You can easily crush metal-cored wire when there is too much tension. V-knurled drive rolls have small teeth to grip and guide the wire; you need less tension to feed the wire down the liner.
- **Longer stickouts won't cause erratic transfer.** The contact tip to work distance—the gap between your welding gun and base material—can be slightly longer when you use metal-cored wire. A gap between 1/2 inch and 1 inch (depending on wire diameter and operating point) works best. Typically, longer tip-to-work distances are recommended as wire feed speed and wire diameter increase.
- **Using a larger wire diameter is OK.** When switching to metal-cored wire from solid wire, you can usually use one wire diameter larger. Since metal-cored wire has a broader arc cone, it concentrates heat less and there is less chance of burn-through. The wire also is better at bridging gaps and providing consistent sidewall fusion.
- **There's less need to manipulate the welding gun and puddle.** The wider metal transfer/arc cone with metal-cored wire allows you to make larger weld beads without weaving.

Equipment and safety

The higher argon levels required for metal-cored wire impact the duty cycle of your gun. Gun manufacturers rate guns for a specific type of gas. Typically, a 100 percent duty cycle rating at a specific amperage refers to using the gun with 100 percent CO₂. Because CO₂ does a better job of cooling the gun than argon does, you may experience a 30 to 50 percent reduction in cooling with high argon gas. Select a gun with enough amperage for the job.

The combination of high argon levels and spray transfer results in lower visible smoke generation—that leads to noticeably more radiant light from the arc since there is less smoke to filter it. The ability to weld metal-cored at higher amperages also increases radiant light. Take extra care to cover exposed skin, increase your welding lens shade and, when necessary, place screens around your welding cell.

Making the right choice

Remember, selecting the right filler metal for the job is an important part of the success of your welding operation. Knowing when it's advantageous to use metal-cored wire can help increase productivity and save money—you can weld more efficiently, deposit more weld metal, reduce quality issues and spend less time cleaning welds in the right applications.