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Advice for Welding with Self-shielded Flux Core Wires

Self-shielded flux cored wires meeting AWS E71T-8 requirements comprise much of the wire used for structural steel in buildings, bridges, civil construction and infrastructure applications. While popular and/or necessary for structural welds, these wires are notoriously difficult to use. Perhaps more than any other tubular electrode, these wires demand special considerations—in both technique and equipment—for obtaining good results.

Greg Metko, a welding engineer with Miller Electric Mfg. Co., has spent thousands of hours training Ironworkers how to successfully weld with self-shielded flux cored wires. For the last 12 years, he has participated in the Ironworkers Instructor Training Program. This program brings together hundreds of instructors who take what they learn and pass it on to thousands of apprentices and journeymen. He is one of the experts dedicated to “training the trainers.” Metko took some time out from a recent training effort to offer the following advice.

Q: Why are self-shielded T-8 so difficult?

A: Because they operate in very narrow voltage range. Take a 5/64-in. diameter wire, which is pretty common. For an all-position fillet weld, its operating range is just 19 to 22 volts. If you make a weld outside of that range, the odds of the weld failing inspection are pretty good.

Q: What happens to the weld if the right voltage isn't used?

A: Excess arc voltage causes porosity, while lack of voltage causes a convex, “humped” or “ropey” bead and potentially insufficient penetration. Extremely low voltage causes “gun buck” where the wire dives through the molten weld pool and stubs on the plate.

Q: What is the most common cause of voltage variations?

A: There are lots of contributing factors, but the one I see the most during training is improper electrode stick-out. When using a flux cored welding gun, this is the distance from the end of the contact tip to the arc. With a self-shielded T-8 wire, the operator needs to maintain a stick-out of 3/4 inch. The contact tip to work distance (stick-out plus arc length) will be about 1 inch.

Q: What happens if proper stick-out isn't maintained?

A: Too little stick-out doesn't allow enough “pre-heat” time for the wire to form the proper shielding gas coverage, which leads to porosity. Too much stick-out will cause the amperage to drop outside of the proper range and the weld may have insufficient penetration. Also, long stick-outs may pre-heat the wire too long, which may change the composition of the wire.

Q: How do welders know if they're using the right voltage?

A: The weld will have little to no spatter, no porosity and a slightly convex appearance. A good way to ensure proper voltage is to use a portable wire feeder with a digital voltage



For good results when welding with AWS E71T-8 flux cored wires, maintain a proper stick-out (3/4 inch) and use the proper gun angle (5 to 10 degrees toward the direction of travel).

display, such as the SuitCase™ X-TREME™ 12VS. It displays voltage while welding and for five seconds after you stop welding. Note that analog meters aren't very accurate compared to a digital display, and any readout back at the power source won't be accurate because long cable lengths common in field welding cause voltage drop.

Q: Other than technique, what else causes voltage problems?

A: Poor weld cables are a common culprit of excess voltage drop. Make sure your weld cables are sized properly and that the cable, clamp and all connections are in good condition.

Q: Should you use a specific type of power source for good voltage control?

A: Yes. To start, welding codes with seismic requirements (e.g., D1.1, FEMA 353) dictate using a constant voltage (CV) power source. Even if procedures don't demand it, Miller always recommends a CV welder for wire welding. This type of machine lets the operator set voltage and wire feed speed/ampereage, which makes it easy to "dial-in" optimum welding parameters.



Ironworkerstrainingcoupon: Floyd Elliff of Local 263 (on right) tests the weld coupon of April Finkbonner from Local 86. This weld shows a slightly convex appearance, so it passes this portion of the weld test.

Q: Are some types of CV welders better than others for voltage control?

A: Yes. With an electric welder, primary power fluctuations can affect weld voltage. Fortunately, some inverters popular for construction work, like Miller's XMT 350 VS, can compensate for voltage spikes and dips. They feature a technology called Auto-Line™ that maintains a steady welding output as long as the primary power remains within a 190 – 630 VAC range. With some engine drives, drawing on generator power while welding (such as using a grinder) may also affect arc voltage. Miller's Trailblazer™ Series and PipePro™ engine drives are specifically designed to overcome this problem.

Q: What's the most common welding advice you give?

A: Maintain proper stick-out and use the proper gun angle. Some T-8 wires simply won't run well if you don't use a drag technique. Point the wire into the leading edge of weld puddle and angle the gun toward the direction of travel by 5 or 10 degrees. It is also critical to keep the wire directed in the molten slag pool, otherwise wire will dive into the plate, stub and create a cold spot. Some brands of wires are more forgiving to use than others, so you might want to experiment.

Q: Do welders need to do anything special during arc starts?

A: Yes. Clip or jog the wire so that you start with the proper stick-out of 3/4 inch. When starting, hold the contact tip about the same distance away from the work as when you're welding (which is 3/4 of an inch), pull the gun trigger, wait a second or two for the arc to establish and the weld puddle to form, and then drag the gun forward. If you experience wire stubbing, start the arc about 1/4 inch further closer, then move it back once it is established. If your wire feeder has a "soft start" or "run-in control," you can use those features to improve arc starts.

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