Weld Repair Keeps Plants Running Efficiently

Portable Inverters Tackle All M&R Welding Needs

Ken Stanzel

Parts wear. Pipes leak. Delivery trucks hit walls. Equipment modifications become after-thoughts. Plant managers and maintenance crews can't always predict when, where, and what will need welding repair in an industrial facility. Fortunately, inverter-based welding power supplies offer the flexibility and portability to handle any plant-maintenance job, keeping downtime to the bear minimum.

For maintenance-and-repair welding in industrial facilities, inverter-based power supplies provide multiple-process capabilities, usually in combinations of shielded-metal- (SMAW) and gas-tungsten-arc (GTAW) or SMAW-GTAW-gas-metal-arc (GMAW)-flux-cored combinations. They produce arcs with unsurpassed quality and can make any weld required. Most importantly, inverters suitable for light maintenance weigh-in at a slight 10 pounds, while machines designed for heavy repair only weigh 76 to 90 pounds.

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Inverters with AC and DC-GTAW capability enable on-site welding of any weldable alloy, and particularly well-suited for high-quality or delicate work. Here, a maintenance welder repairs a worn steel machine part.

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Typical inverters for MRO

A basic inverter for maintenance-welding applications has SMAW and GTAW capabilities, DC weld output from 1 to 140 or 200 amps, and a weight of 10-40 pounds. Retail price is approximately $800 to $1,500, $200 to $500 more than a conventional power supply. To justify the added cost, simply calculate the man-hours required to move a heavy transformer-based welding power supply to a repair site, or the time and effort needed to bring the part needing repair to the welding shop. Now compare that cost to picking up an inverter with one hand and getting the job done.

A more-advanced SMAW-GTAW inverter has a greater weld output for thicker workpieces—300 amps should suffice for most repair work; perhaps AC-DC output capabilities; and maybe the ability to carbon-arc gouge and cut. The AC output is required for GTAW on aluminum or other nonferrous alloys. Shops use the DC weld output for GTAW on all ferrous alloys, as well as for any SMAW.

For maximum flexibility, look for an inverter with wire-welding capabilities, GMAW and FCAW, in addition to SMAW-GTAW. These inverters usually have a DC weld output of 5 to 400 amps, meaning they can weld anything from very light sheetmetal to heavy plate. These machines retail for about $3,000; as an attachment, a portable suitcase-style wire feeder runs about $900, and a GTAW set-up—torch, remote current control, and gas regulator—costs about $500. Using this set-up, an MRO welder can perform more work than with any other arrangement, making it the optimum investment in welding equipment for larger facilities.

When examining inverter-based power supplies for maintenance welding, engineers should look for machines with a simple front-panel control so that anyone can understand how to use it. Newer models on the market carry a minimum number of control knobs—a process-selector knob, a dial for adjusting amperage, and a knob for controlling arc dig and inductance should suffice. Other than connecting the desired wire feeder, torch, or stinger, an operator need not make any other adjustments to switch between processes.

Process	GMAW	FCAW	SMAW	GTAW
Type of alloys it can weld	Steel, stainless, aluminum	Steel, stainless	Steel, stainless	All weldable materials
Workpiece thickness	22 gage and up	1/8 inch and up	1/8 inch and up	22 gage and up
Welding speed	Very fast	Very fast	Slow	Very slow
Skill required	Some skill	Some skill	More skill	Most skill
Purchase cost	Moderate	Moderate	Low	High
Operating cost	Low	Low	High	High

AMPERAGE NEEDED TO WELD MILD STEEL IN ONE PASS

Thickness, in.	1/16	3/32	1/8	1/4	1/2
SMAW, E6013	20-45	40-90	80-130	250-350	300+
GMAW	100-120	125-145	140-150	180-190	300+
FCAW	N/A	110-125	140-155	170-190	430-470
GTAW	55-90	90-120	95-130	245-330	330-440

Approximate welding amperage used for various thicknesses of mild steel. Actual amperage used depends on the type of weld—butt, lap, fillet, corner, welding position—flat, vertical down, vertical up, overhead, diameter of electrode, type of shielding gas, and other factors. Remember, thicker material can be welded by making multiple passes.

Weight-watching maintenance crews specify inverter-based power supplies for welding to enable welders to easily move around an industrial facility to make timely repairs. Here, an operator shielded-metal-arc welds to repair a garage-door runner. Note how light he travels — just the power supply, electrode, and electrode holder.

For applications requiring wire welding, such as the HVAC application shown here, purchase an inverter that enables flux-cored-arc welding. By welding with a self-shielded wire, the welder need-not carry a heavy, clumsy gas cylinder around the plant.

Have power, will travel—weight loss explained

Outside of preventative-maintenance activities, a shop maintenance foreman can't predict what type of equipment will need welding repair, or the location of the equipment. This means he has no way of knowing if he'll be able to bring the work to the welder and his power supply, or if he'll have to bring the welder and his power supply to the work. An inverter's light weight makes it hand-portable, eliminating this classic dilemma.

Understanding how inverters went on a weight-loss program requires a quick explanation of how these machines transform line power—high voltage, low amperage—into welding output power—low voltage, high amperage. The amount of current a power supply can transform depends on the size of the core area, the number of wire wraps around the core, wire diameter, and the frequency of incoming power. Conventional supplies operate with the 60-Hz current coming from the power station. They transform power with a large iron core wrapped with copper or aluminum wire. This makes them heavy. To handle the current used to weld 3/8-inch-thick aluminum or 1/2-inch steel, a power-supply transformer must weigh 200 pounds or more.

Inverters operate on the principle that by doubling the current frequency, either the core size or the number of wire turns is halved. Quadruple the frequency, and both can be halved, and so on. Before the current reaches the transformer, an inverter boosts the line frequency to 20,000-100,000 cycles/s using special power-switching semiconductors similar to those found in adjustable speed drives, but much more rugged. The end result: their transformer can weigh less than a bowling ball.

Flux-cored-arc welding is less affected by drafts and therefore better suited for outdoor maintenance welding.

This advanced input-power capability provides another benefit for maintenance personnel: depending on the specific model, some inverters automatically accept any primary input voltage. No wiring changes or alterations are needed to accept either 230- or 460-volt, single- or three-phase, 50- or 60-Hz input.

Narrowing the choice

Before examining specific inverter-based welders, maintenance personnel need to determine which welding processes best suit their needs.

Shielded-metal-arc welding. This process uses a consumable flux-coated electrode of mild steel, stainless steel, cast iron, and various other alloys. Other than safety gear, it requires no equipment other than the power supply, electrodes, an electrode holder, and a work clamp, plus a wire brush and chipping hammer to clean the finished weld.

The process works on most metal alloys, can weld outdoors, offers simple equipment set-up, and is forgiving when welding on dirty or rusty work. However, welding thin materials may be difficult or impossible, require a highly skilled operator when welding aluminum, and runs up to four times slower than wire welding.

Most applications require only a DC weld output because DC welding provides easy starts, fewer arc outages, less electrode sticking, less spatter, easier out-of-position welding, an easier learning process, a smoother arc, and less chance of blowing through on thin metals.

Gas-tungsten-arc welding. This process uses a non-consumable tungsten electrode and a shielding gas (usually argon) which protects the welding area from contamination by the atmosphere. It requires a power supply, work clamp, torch, remote amperage-control device, tungsten electrodes, filler rods to match the base material, shielding-gas cylinder, plus hoses and regulators. For extended welding over 200 amps, consider a water-cooling system for the

torch. For improved arc starts and better welds in the AC mode, some facilities add a high-frequency unit.

The process works well on thin materials, with minimal distortion; allows the operator to precisely adjust heat input while welding by using foot- or hand-operated remote amperage control; and welds any weldable material. However, it progresses slowly and demands a high level of operator skill. In all, optimum weld quality coupled with the flexibility to weld any weldable material makes a GTAW power supply a good choice for maintenance work.

Gas-metal- and flux-cored-arc welding. In these processes, a continuously fed wire functions as a consumable electrode. These are the easiest processes to learn—with a little practice, first-time operators can achieve good-looking welds. Wire welding joins light-gage material as well as thick plate. Continuous wire feed minimizes starts and stops, resulting in high welding speeds for the fastest repair or construction time possible.

Welding outdoors or in drafty areas does not work well with GMAW because drafts can blow the shielding gas away from the weld puddle, which can degrade weld quality. Also, the need to use heavy gas cylinders can limit mobility. However, use of self-shielding flux-cored wires overcomes these limitations. Flux-cored welding is less affected by drafts and therefore better suited for outdoor maintenance welding; works as well as SMAW on rusty or dirty material; and offers deep penetration for welding thick sections — the process is not suitable for work thinner than 3/32-inch.

Given that each welding process has its strengths and weaknesses, maintenance personnel can gain maximum flexibility by choosing a multiple-process inverter-based power supply. Compared to a single-process machine, these can provide a better return on their purchasing dollar.

How much power do you need?

One way of classifying power supplies is by how much amperage they can generate at a given duty cycle. Basically, amperage equals heat. For thin work, maintenance welders need low-end amperage control to prevent burnthrough. For thick work, they need sufficient amperage to ensure good penetration.

Duty cycle is the number of minutes out of a 10-minute cycle a power supply can operate. For example, a machine that can deliver 300 amps of welding current at a 60-percent-duty cycle can weld continuously at 300 amps for six minutes, and then must cool down for four minutes to prevent overheating.

Duty cycle and amperage are inversely proportional. Operating at 250 amps, the same machine has a 100-percent-duty cycle—it can weld without stopping at this amperage. Operating at 400 amps, it has about a 20-percent-duty cycle.

Next, consider amperage requirements based on the thickness range of the work required. For example, GMAW of 18-gage steel in a single pass takes about 70 amps, where welding 1/2-inch steel in a single pass requires about 315 amps. ■