

# WELDING *Journal*



JANUARY 2021



**Cold Spray Technology**

**Industry Perspectives**

**Engine-Driven  
Welding Machines**

**Q: My boss recently put me in charge of resistance welding at our plant and the process is new to me. What do I need to know to avoid problems?**

**A:** Although resistance welding has been widely used in manufacturing for decades, the process is not well understood outside of the automotive industry.

Unlike arc welding, which produces a bead that can be checked visually, successful resistance welding hinges on understanding the process, setting up the machine properly, and controlling all the variables.

Here are a few tips to get you started.

## Choose the Right Welding Machine

Resistance welding machines come in many different sizes and varieties, and it's important to choose the right one for the job. Although a rocker arm spot welding machine (Fig. 1) is the least expensive and most versatile type in use today, a vertical action press-type spot welding machine (Fig. 2) is recommended when weld appearance needs to be optimized. Also, press-type welding machines are best suited for projection welding applica-

tions that include nuts and studs.

When welding a large part that is not easily manipulated by the operator, consider using a portable spot welding gun hanging from an overhead spring balancer.

## kVA Rating

Comparing welding machines solely by their kVA rating confuses the task of machine selection because kVA can be inflated if the U.S. industry standard of 50% duty cycle is not used. Because kVA is a thermal rating, a welding machine with a lower duty cycle rating results in a higher kVA number on the data plate.

As an example, a machine rated 100 kVA at 50% duty cycle may also be rated 141 kVA at 25% duty cycle and 224 kVA at 10% duty cycle. This inflated rating is common for many imported resistance welding machines.

Secondary welding amps actually do the work, and a spot welding machine's throat depth is a critical variable in machine selection. As an example, a 100-kVA single-phase alternating current (AC) welding machine with a 12-in. throat will produce significantly more amps than the same machine with a 36-in. throat measurement. This is due to losses in the secondary loop.

Other throat depth considerations for rocker arm spot welding machines include the mechanical design of the force delivery system because, with everything else being equal, 12-in. arms will produce much more weld force than 36-in. arms.

## Alternating Current/Direct Current

Although single-phase AC resistance welding machines were the industry standard for many years and are still in widespread use, welding machines with three-phase medium-frequency direct current (MFDC) power supplies are now taking over the higher end of the market, especially when welding advanced high-strength steel (AHSS) or aluminum.

In addition to the advantage of direct current (DC) output, which is superior to AC, three-phase medium-frequency machines present a balanced electrical load and draw less primary amperage when compared to a similar single-phase spot welding machine.

## Purchase Setup Tools

The three main variables of resistance welding are secondary amps, weld time (current flow duration), and forging force. This is sometimes referred to as HTP (heat, time, pres-



*Fig. 1 — If you're looking for the right resistance welding machine for your facility, the rocker arm spot welding machine is less expensive and more versatile.*



*Fig. 2 — The vertical action press-type spot welding machine is recommended when weld appearance needs to be optimized.*

sure). These variables can be adjusted on the machine, and charts are available for mild steel and other alloys that will give you the initial settings (see the Resistance Welding Manufacturing Alliance [RWMA] manual referenced near the end of this column).

If your plant does not already own a gauge for measuring the force between the tips and a secondary amperage meter for measuring the output of a resistance welding machine, now is the time to buy these important setup tools.

Taking time to experiment with various welding machine and control settings will pay dividends in weld quality — Fig. 3. A tensile pull machine is the best way to test welds, but destructive testing by peeling the weld apart can also confirm strength.

## Organize a Detailed R&D

Several combinations of resistance welding variables will work for mild steel. However, for best weld strength and appearance, a relatively high amperage setting and a short weld time will produce a good weld without excessive marking and expulsion.

If your plant is welding aluminum or the AHSS alloys now common in the automotive industry, choosing the proper settings for all three variables is more critical because the window for success is much smaller than mild steel.

Taking the time to do a thorough R&D experiment to determine the optimum “weld lobe” settings will pay off in consistently high weld strength.

## Use the Force

Since weld heat is generated by the electrical resistance of the material being welded, and this electrical resistance is dependent on the force between the welding electrodes, setting the proper forging force is critical. Just like Goldilocks’s porridge, a weld joint that’s “just right” will result from using a force setting that produces weld heat that’s not too hot and not too cold.

Too much force will reduce resistance and result in a cold weld, whereas low weld force can cause expulsion. The correct force for a particular metal

thickness and alloy can be found on the chart.

An air cylinder that’s too small will run out of available force, and a cylinder that’s too large will not produce the weld followup required to properly forge the joint.

Some new machines now have electric servos to provide a wide and easily adjustable range of weld force.

Check to make sure your parts fit together intimately because the welding machine should not be used as a forming tool. If there’s a gap between the parts, “spring back” will rob the process of needed weld force.

## Well-Dressed Tips

Choosing the proper copper electrode type, geometry, and alloy is critical.

Somewhat like tires on a car, “where the rubber meets the road,” resistance welding electrodes, commonly called tips, are the only connection between the welding machine and the part being welded.

And, regardless of whether the welding machine is a basic rocker arm or a press-type machine, welding current and force must pass through the electrodes to form a strong weld nugget at the interface of the material being welded.

## Be Cool

Water cooling is critical to long tip life and it’s important to make sure that water tubes are properly installed. These tubes are designed to circulate water all the way into the end of the tip’s internal water-cooling cavity.

To ensure proper water-cooling flow and temperature, consider connecting your welding machine to a recirculating water chiller. To avoid condensation, set the water temperature above the prevailing dew point.

## Picture This

Think of the electrode’s weld face as a “printing press” that leaves a picture of the tip’s weld face each time a weld is made. Since tips mushroom over time, it is imperative to maintain the

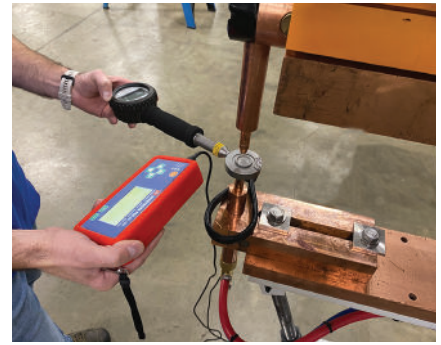


Fig. 3 — Investing in a weld force gauge and weld amp meter will pay dividends.

original tip-end configuration through a consistent program of dressing, either on the machine or offline. Dressing or replacing the tips before it’s absolutely necessary will pay dividends.

## Education

As you’ve probably realized by now, there’s much more to the resistance welding process than meets the eye. Fortunately, there are single- and multi-day training classes available through the American Welding Society (AWS); the RWMA, a Standing Committee of the AWS; and private outlets. These classes cover much more than we have outlined here.

Even if you don’t attend a class, buy the *RWMA Resistance Welding Manual, Revised 4<sup>th</sup> Ed.*, which is available from the AWS Bookstore ([pubs.aws.org/p/323/rwma-resistance-welding-manual-revised-4th-ed](http://pubs.aws.org/p/323/rwma-resistance-welding-manual-revised-4th-ed)).

## Become a Pro

Once properly trained, you might want to consider studying for and taking the 100-question multiple choice exam to become an AWS Certified Resistance Welding Technician (CRWT).

Similar to the AWS certification program for arc welding technicians, the CRWT training and certification program will enhance your professional standing in the industry.

You can find information at [aws.org/certification/page/certified-resistance-welding-technician](http://aws.org/certification/page/certified-resistance-welding-technician). 