

Somewhat like tires on a car, “where the rubber meets the road,” resistance-welding electrodes, commonly called tips, are the only connection between a welding machine and the part being welded. Here’s some solid advice on how to select, use and maintain the electrodes.

BY TOM SNOW

“It’s funny how one of the least-expensive components of a resistance welding (RW) machine can cause the most weld-quality issues,” says Don DeCorte, vice president of sales at RoMan Manufacturing, Grand Rapids, MI, a manufacturer of RW power supplies, and chairman of the Resistance Welding Manufacturing Alliance (RWMA), a standing committee of the American Welding Society (AWS).

“The importance of proper electrode selection and main-

tenance often is overlooked or taken for granted,” continues DeCorte, who has been involved with RW for more than 40 years. “Resistance welding is a mystery to many people and electrodes are one of the most misunderstood components of the process.”

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Face Configuration

Electrode tips for RW are made from various copper alloys, selected to suit the application, with the most common being RWMA Class 2, an alloy of copper and chromium. When compared with pure copper, about 15 percent of a Class 2 alloy’s electrical conductivity is sacrificed in order to increase physical strength, which helps to prevent electrode deformation under welding heat and force.

Suppliers of RW tips offer other grades developed specifically for welding galvanized steel, stainless steels, and aluminum- and nickel-based alloys. Most often, metal formers will want to use an RW electrode with a straight, pointed-nose tip, and a ¼-in.-dia. weld face. Other face configurations

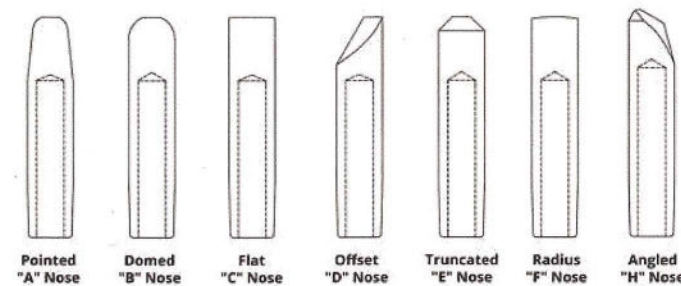


Fig. 1—Weld-face configurations can vary according to specific applications.

(Fig. 1), designed for specific applications, include offset, dome, flat, radiused and truncated.

Tips with an offset nose facilitate reaching into a narrow flange. They can prove difficult to properly dress, and this design limits the amount of weld force that can be used. Therefore, only use offsets when necessary.

Domed electrodes find a lot of use in the automotive industry, because they can help solve alignment issues and are easily dressed in an automated process. Flat-faced tips find use for applications requiring a good “show surface,” although weld heat must be concentrated from the opposite side of the weldment with a pointed or domed-tip electrode. When making show-surface spot welds, think of the electrode’s weld face as a printing press, because each weld will leave a “picture” of the tip end.

Welding aluminum? Electrodes with a slightly radiused weld face find use here. And, according to Bill Brafford, who retired after a long career with RW electrode manufacturers CMW and Tuffaloy, “when welding galvanized material, use tips with a truncated nose, because the unavoidable expulsion will not form a ‘dam’ around the weld face.”

Well-Dressed Tips

Unlike arc welding, the RW process does not consume the copper electrodes. However, over time, the tip’s contact surface mushrooms, due to a few reasons: the heat generated from a workpiece-material’s electrical resistance; the physics of applying high weld-forging force; and the lack of supply of well-refrigerated cooling water to the electrode.

Therefore, metal formers must perform some form of tip dressing to return the electrodes to their original configuration. Dressing options include the basic, but relatively inaccurate, radiused hand file, or pneumatic dressing tools, which an operator can use while the tips remain installed in the welding machine (Fig. 2). However, for optimum results, dress tips offline in a drill press equipped with special cutter blades.

Unique to robotic RW cells are automated tip-dressing stations, which work like a motorized pencil sharpener. For best results, program the dressing operation to occur well before the tip faces begin to mushroom and negatively

affect weld quality.

Wondering about the importance of proper electrode dressing? Consider tests performed on new ¼-in. weld-face pointed nose tips, and using a secondary weld current of 9800 A to produce sound welds. Allowing the tip face to mushroom just slightly, to 3/8-in. dia., which increases the surface area by 25 percent, now requires 22,100 A of weld current to form high-quality welds. Failure to increase welding current to compensate will lead to the formation of weak welds.

Caps and Shanks

To save money, consider substituting caps and shanks for standard one-piece RW tips. This combination allows you to reuse the electrode shank when replacing the small cap tips due to wear. Select from several versions of caps and shanks, including male, female, through-hole and blind-hole. Electrode shanks with blind holes allow cooling water to remain flowing while replacing the caps. However, this convenience results in faster mushrooming because cooling



Fig. 2—An operator can use a pneumatic weld-tip-dressing tool while the tips remain installed in the welding machine.

water does not reach as close to the weld face as it does when using through-hole shanks.

RW-equipment suppliers offer several types of cap-extracting tools. Two of note: Tuffaloy (www.tuffaloy.com) and CMW (www.cmwinc.com). Note: Applying a thin layer of conductive

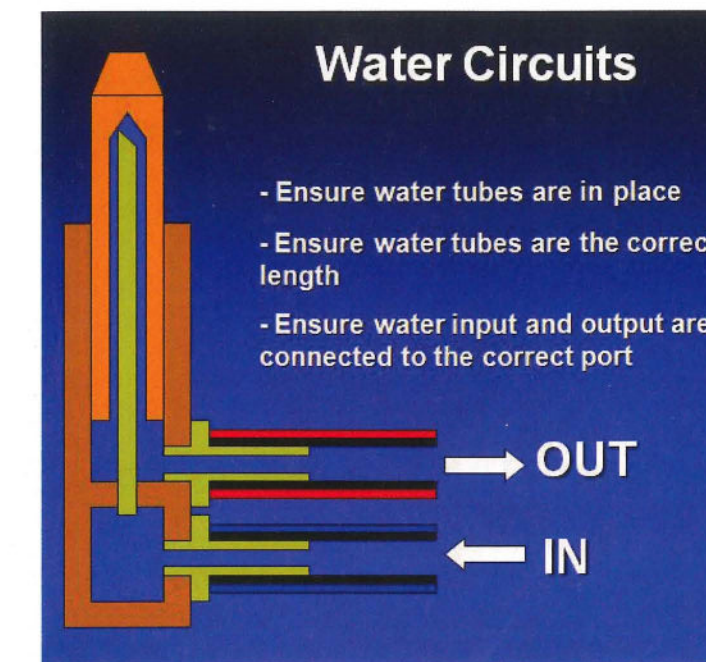


Fig. 3—Proper water cooling is critical to long electrode life, with success hinging on forcing cooling water inside of the electrode, as close as possible to where heat is generated during the weld.

grease on the taper prior to installing tips will make them easier to remove.

Tapers

Some RW tips have threads, but most have a tapered shank that engages with the electrode holder to provide good electrical conductivity and a watertight seal. Select from several different tapers, the most common being #5RW, an RWMA designation equivalent to a #2 Morse Taper. Other options include ISO tapers and tips from Asian suppliers; it’s important to know which style your welding machine requires.

In addition, shops can return worn internal tapers of electrode holders to their original condition using a reamer. And, never use Teflon tape or pipe compound on the taper to stop water leaks.

How Long Do Tips Last?

That’s a common question, and the standard answer is, “it all depends.” Many RW applications are unique and tip life will vary greatly based on the workpiece material, and whether the metal former has properly optimized RW-machine settings.

Proper water cooling is critical to long electrode life and most tips come with drilled internal water passages. Copper, brass and plastic tubes with one end cut on a 45-deg. angle will help force cooling water inside of the electrode, as close as possible to where heat is generated during the weld (Fig. 3).

Unfortunately, operators oftentimes will not understand the importance of water tubes, and will lose them or throw them away—a costly mistake. In addition, pay attention to the temperature of the cooling water supplied to the electrodes, to prolong life (see the accompanying sidebar).

When welding coated steels, such as galvanized, the tip’s weld face will tend to pick up some of the coating, and, therefore, will require dressing more often than when welding bare steel. RW of aluminum alloys can be even more challenging, since aluminum wants to alloy with the copper tips. Because of this alloying effect, the weld face may require dressing after only a few welds.

Other tip-life considerations include a solid understanding of the three main RW process variables—welding amperage, forging force and welding-current on time. To optimize tip life, seek to adjust these variables to produce the required weld strength with the shortest possible weld time. While

The Importance of Proper Water Cooling

by Roger Hirsch, president of Unifrol Electronics, Northbrook, IL, a manufacturer of RW controls and recirculating water chillers.

I recently received a call from the welding engineer at a Tier Two manufacturer, explaining that she had been experiencing poor electrode life from the firm’s 35 RW machines. With this many machines, replacing the copper electrodes proved quite costly, but not as costly as the lost production time required to replace the electrodes.

In a 2-yr. study, the company found that it had to replace its RW electrodes 30-percent more frequently during the summer months compared to winter months. Since production load did not vary by season, I surmised that the temperature of the water being used to cool the electrodes was the culprit. Further investigation revealed that the temperature in the water tower supplying the RW machines was 15 to 20 deg. higher during the summer than the winter.

The solution: Eliminate the water tower and install a refrigerated-water system in the plant’s welding department. And, as an aside, this setup also eliminated water contamination from the water tower, which periodically clogged the cooling tubes inside of the electrode holders.

After installing the refrigerated-water system, electrode life improved by 25 percent when compared to the best electrode life recorded during the coldest winter months, and did not change by season.

shops can refer to charts that recommend parameter settings based on workpiece material and sheet thickness, only consider these as a starting point.

An Alternative to Offset Tips

Finally, while some applications will require the use of double-bend offset tips, to access difficult-to-reach weld locations on narrow flanges, for example, shops should avoid offsets where possible. Offsets will tend to deform due to low physical strength and poor water cooling—particularly when using expensive offset tips made from copper castings.

In place of offset tips, try using a standard, straight tip, with an offset nose mounted in an offset electrode holder. Consult available tip catalogs for illustrations of various electrode and holder combinations that will provide the required reach into challenging weld locations. MF