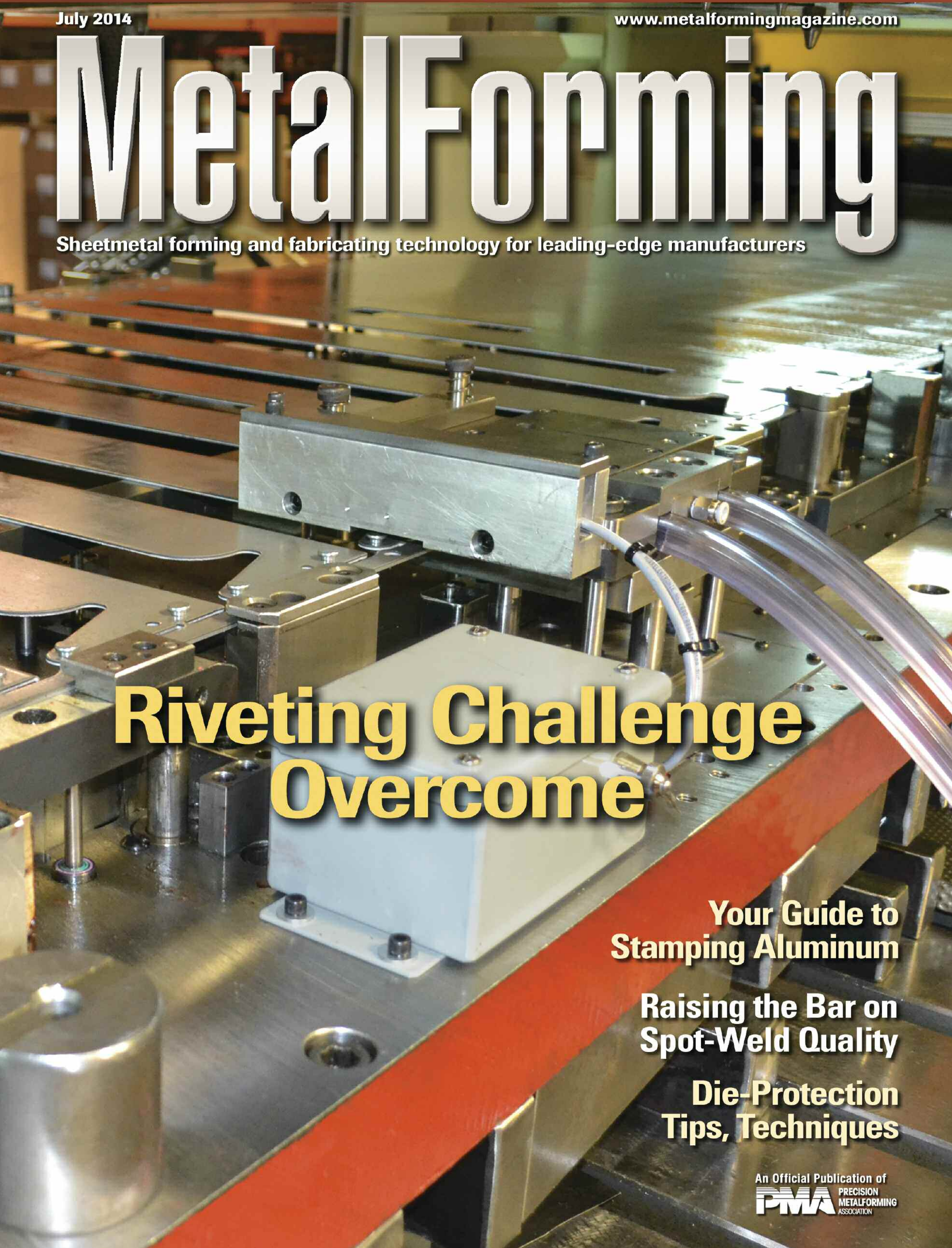
Say "So Long" to Skin Injuries | New Manufacturing Software

July 2014

www.metalformingmagazine.com

MetalForming

Sheetmetal forming and fabricating technology for leading-edge manufacturers



Riveting Challenge Overcome

Your Guide to Stamping Aluminum

Raising the Bar on Spot-Weld Quality

Die-Protection Tips, Techniques

An Official Publication of PMA PRECISION METALFORMING ASSOCIATION

How to Improve Spot-Welding Performance

Resistance spot welding is a popular value-added secondary operation for many metalformers, but the process often is ignored until quality problems arise. When a customer calls to report that all the parts you just produced have been rejected due to bad spot welds, suddenly the process takes on a whole new level of importance.

BY TOM SNOW

Although rocker-arm RSW machines are the most common due to their relatively low purchase price, they apply weld force with a lever action—the tips often skid if the arms are not perfectly aligned. Therefore, a more-expensive vertical-action press-type machine (shown) often gets the call when the application requires an attractive, low-marking show surface.

Since weak spot welds may look similar to strong ones, how do you stay out of trouble? Here are some suggestions for improving your resistance spot-welding (RSW) performance, based on more than 40 years of experience.

1) Get trained on the RSW process.

Spot welding appears deceptively simple, but numerous process variables must be understood and controlled. With many different settings available on the typical spot-welding machine, it's important to understand how to adjust each setting for optimum results. And, just like baking a cake, it's critical to use the right spot-welding recipe.

Metalformers should refer to readily available recipe charts, which prescribe the recommended settings for secondary amps (weld heat), weld duration (current flow time) and forging pressure (forc e) for spot welding various sheetmetal types and thicknesses. Note: Use these settings only as a starting point. A rule of thumb: Assuming the proper welding force is used, the strongest and most attractive joints typically result from a high heat setting and a short weld time, referred to as a Class A welding schedule.

Tom Snow is CEO of T. J. Snow Company, Inc., Chattanooga, TN, a manufacturer, remanufacturer and distributor of resistance-welding machinery, supplies and accessories: 423/894-6234; www.tj-snow.com. He also serves as first vice chairman of the Resistance Welding Manufacturing Alliance, and heads its Education Committee.

Class B and C welding schedules often find use when a metalformer uses a welding machine too small for the material thickness being welded. These schedules include lower force ranges and longer weld times, which result in lower weld-shear strength and more surface marking, due to a larger heat-affected zone.

Skilled-labor retirements and lay-offs during the past few years have reduced the tribal knowledge of many shops performing spot welding, but several sources offer books and training courses on the process. For example, the Resistance Welding Manufacturing Alliance (RWMA), a standing committee of the American Welding Society (AWS), sells an excellent manual on resistance welding and offers various technical papers on the subject. It also offers a two-day resistance-welding course each fall in conjunction with FABTECH.

Additionally, the AWS is about to roll out a formal certification program for the resistance-welding process, which will no doubt spawn training courses designed to prepare applicants to take the Certified Resistance Welding Technician (CRWT) exam.

2) Select the right welding machine.

The most important thing to remember: Select a machine than can make optimum-strength Class A welds with about 25 percent of its available amperage and force range left in reserve.

Most companies are not equipped to properly size a machine on their own, so heed the advice of an experienced machine builder. A good sales engineer will quote a machine only after asking questions about the materials to be welded and the speed at which the machine will operate.

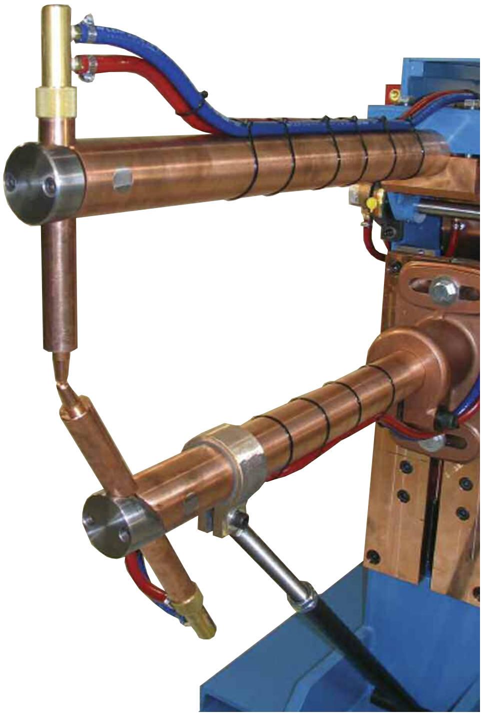
Since an RSW machine's KVA rating can be inflated by using a duty cycle of less than the RWMA standard of 50 percent, be sure to ask if the machine being quoted meets those standards.

Although rocker-arm RSW machines are the most common due to their relatively low purchase price, they apply weld force with a lever action—the tips often skid if the arms are not perfectly aligned. Therefore, a more-expensive vertical-action press-type machine often gets the call when the application requires an attractive, low-marking show surface.

A welding machine that's too large can cause just as many problems as one that's too small, especially when the air-cylinder diameter is so oversized that it must be run on an air-line pressure below 40 lb. to achieve the desired weld force.

Unacceptable weld strength can result from inadequate air-cylinder follow-up action at the instant the sheetmetal reaches the molten state, when it needs to be properly forged.

To accommodate the new high-strength steels finding use in the automotive industry, manufacturers of RSW machines and controls have



To avoid skidding, arms and tips of a rocker-arm RSW machine must be perfectly aligned.

made significant advances. For example, machines equipped with mid-frequency direct-current (MFDC) three-phase inverter power supplies have become common in job shops because they offer many advantages over the traditional single-phase AC machine.

So, ensure good quality by replacing or rebuilding your tired, old RSW machines, or at least retrofit them with new programmable controls.

3) Use the right setup tools.

To make sense of spot-welding recipe charts, every shop using the process should own a specialized resistance-welding amp meter to measure the secondary RMS welding current delivered to the tips. In addition, since lever-action variables (on a rocker-arm RSW machine) and ram friction (on a vertical-action press-type machine) can impact the weld force delivered, shops also should have a direct-reading gauge to measure the actual weld force between the tips.

Using a secondary amp meter and force gauge enables an RSW-machine operator to set up the machine scientifically rather than through trial-and-error. And, when documentation is required, some of the available meters also can serve as monitors to record and store welding variables for reference.

4) Use a tensile tester.

Testing spot welds should be more scientific than dropping welded parts on the floor. Although a mechanical peel or chisel test can be a useful way to visually check weld strength and nugget diameter, the best quality-assurance tool is a tensile tester designed to pull small welded sample coupons to failure. The shear strength of a good spot weld should exceed than that of the parent material.

5) Determine the weld lobe.

Due to its wide plastic range, low-carbon steel can be successfully spot welded with various machine settings. However, to determine the ideal setting a metalformer must experiment with the welding machine and use a tensile tester to check the results.

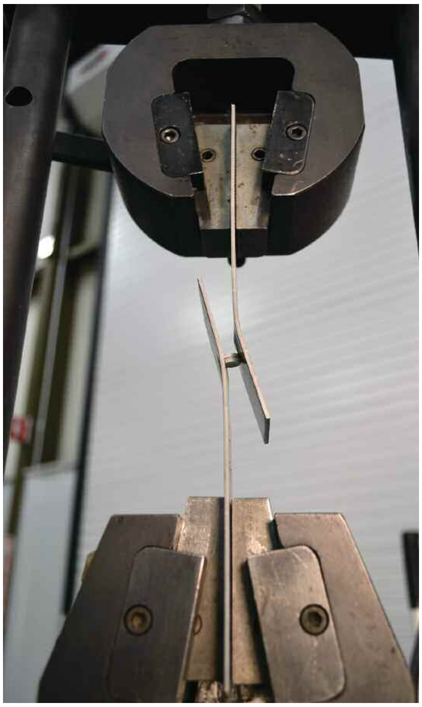
At the low end of the weld-lobe window, weld strength is unacceptable; at the high end, expulsion occurs. To zero-in on the optimum settings for the material being welded, the operator should confirm the optimum weld recipe and use those parameters as a starting point for the production run.

Weld strength will decrease as the electrodes wear, but starting in the middle of the acceptable range, rather than on the “ragged edge,” allows the process to be most stable and reliable.

6) Use the right electrode tips and holders.

Tip selection plays an important role in successful spot welding and there are numerous electrode shapes and copper alloys available from which to choose. Again, rely on the advice of a knowledgeable vendor for guidance.

For example, rather than using expensive offset electrode tips, a vendor may recommend using an offset holder and a less-expensive straight tip. In addition, using small, replaceable electrode caps rather than traditional one-piece electrodes can yield significant savings.



Testing spot welds should be more scientific than dropping welded parts on the floor. Although a mechanical peel or chisel test can be a useful way to visually check weld strength and nugget diameter, the best quality-assurance tool is a tensile tester designed to pull small welded sample coupons to failure.

And, to maximize electrode life, use tubes with ends cut on a 45-deg. angle to force water all the way to the bottom of the tip’s internal cooling chamber.

7) Dress tips early and often.

Since most RSW quality issues can be traced directly to electrode wear, metalformers cannot afford to neglect electrode tips. Dressing or exchanging tips on a regular basis—long before required—will pay big dividends. Here’s an example of the importance of tip dressing:

RSW charts often recommend tips with a ¼-in.-dia. weld contact face. Let’s assume you’ve determined that the material you’re welding requires 9800 A for optimum weld strength. Here’s the rub: If nothing else changes and the tips mushroom from ¼-in. dia. to just ⅜ in., which is hardly noticeable, lab tests have shown that 22,100 A would be required to get the same strength. It’s situations like this that result in weak spot welds and rejected parts.

While metalformers can select from several types of tip dressers, the best method of maintaining the proper weld-face diameter is to remove the electrodes from the machine after a predetermined number of welds, long before they've mushroomed out of control. Dress the electrode tips offline with a lathe or drill press equipped with the proper cutter blades.

8) Design for resistance welding.

Metalformers can reference charts listing minimum contacting overlap, and designers of spot-welded sheet-metal parts should include adequate flange widths to avoid expulsion, which lessens weld strength. Additionally, carefully consider weld spacing. Placing spot welds too closely together can result in shunting. Here, some of the welding energy is lost through adjoining welds, possibly resulting in substandard weld strength.

Springback of the parts being welded also can plague the RSW process. Using a portion of the welding machine's available weld pressure to force the parts together can compromise proper forging of the weld.

9) Purchase steel of known quality.

RSW problems sometimes can be traced back to a coil of steel purchased at an attractive discount, but of dubious quality. High carbon content can cause serious welding problems, as can inconsistent coating thickness. If the welding machine is not adjusted properly to accommodate these variations, welds that look good may fall apart.

10) Schedule regular preventive maintenance.

RSW machines typically don't see the regular preventive maintenance (PM) they deserve. Machine performance degrades over time, due to corrosion and/or arcing of the numerous copper-to-copper secondary connections carrying current from the transformer to the tips. Therefore, metalformers should disassemble, clean and tighten the entire secondary loop at least once per year. They also should regularly examine the force-delivery system and repair any air leaks and mechanical wear. **MF**

Since most RSW quality issues can be traced directly to electrode wear, metalformers cannot afford to neglect electrode tips. Dressing or exchanging tips on a regular basis will pay big dividends.