Procedures for Proper Welding

By Larry Montanez III, CDA and Jeff Lange, PE with Steve Baur

The repair of collision damaged-vehicles calls for a multitude of procedures and protocols for the correct return of the vehicle to "pre-collision" condition. One of the most important (and common) procedures is welding. The welding procedures can come in the form of MIG/GMAW (Metal Inert Gas/Gas Metal Arc Welding), STRSW/RSW (Squeeze Type Resistance Spot Welding/Resistance Spot Welding), Weld-Bonding (Structural Adhesive with STRSW) or, in some limited applications, MIG Brazing (Metal Inert Gas with Silicon Bronze wire). Clearly, there is a plethora of welding options. The welding method chosen for the replacement of panels will be based in part on the type of weld joint, butt joint/open joint, butt joint with backing/insert, lap flange, plug on lap, RSW on lap and a flanged joint. In addition, the material to be welded must also be considered. The correct repair will require all these options to be considered and more.

With the advent of the "New Advanced Steels" utilized to construct today's vehicles, you will need the repair information to repair the vehicle correctly. The type of joint and welding method will be dependent on OEM recommendations or "General Procedures." Doing it any way you want is no longer acceptable. Most OEMs have recommendations on the proper methods and techniques to use. Utilizing the OEM Technical Information website (**http://oemonestop.com**), the I-CAR web link **(www.i-car.com/html_pages/technical_information/technical_info.shtml**) or even easier, ALLDATA Collision Connect information (**http://alldatacollision.com**) will help you determine the type of weld process, joint configuration and sectioning locations.

Before starting a repair, you will need to ask yourself some questions:

- When is it okay to MIG/GMAW weld a panel on? MIG is not always an acceptable method. An example would be most panels made of UsiBOR/Boron steel often found in Audi Q5 B-Pillar and Mercedes Benz S Class B-Pillar/Rocker Panel assembly.

- Where can I section the panel? Some manufacturers will not allow sectioning due to the construction or the material used. For example, Honda does not allow sectioning of their front lower uni-rails.

- Do I section the joint with or without a backing/inset plate? This can be a tough decision. Toyota requires open butt joint on outer panels and structural parts, while GM requires a backing/insert plate on outer panels and structural parts. This is why it is important to have the OEM information. An improper weld choice may result in an improper repair, which puts you and your customer at risk.

- What MIG/GMAW welder do I use? Well, this is pretty simple. With MIG/GMAW uni-body vehicles, you will be using a 110v welder with .023, .024, .025 ER-70S-6 or, in some cases, ER-70S-3 wire. In the case of full frame repair, you will be using a 220v welder with .030 ER-70S-6 wire or .035 ER-70S-3 wire. This will depend on the type of substrate and OEM recommendations.

You might ask yourself how your technicians will keep up with today's ever-changing procedures. The answer is that keeping up with the ever-changing world of auto repair requires diligence and access to data. As discussed above, the information you need is available, if you take the time to look. For example, welding and panel replacement procedures are changing from year-to-year and model-to-model. Having 30 years' experience is no longer enough; training is paramount, especially in these tough economic times. Over the past 10 years, the only thing that has remained constant in this industry is change. Now all we need is the information on how to repair today's new vehicle designs. I know I am making this sound easy, but it can be if you take the necessary steps and make it part of your SOP (Standard Operating Procedures). Let's start by going over some procedures and how they differ from OEM to OEM.

When replacing a GM lower uni-rail, many GM vehicles are attached to a Laminated Steel dash panel/firewall. GM states in their repair procedures that the uni-rail MUST be adhesively bonded and riveted to the dash panel. (This is known in the industry as "rivet-bonding.") The remaining part of the rail that attaches to the floor panel can either be MIG/GMAW or RSW in place. GM provides sectioning procedures for the front half of the uni-rail on many of their vehicles. Generally,

those procedures are forward of the strut tower. Toyota/Lexus/Scion and Nissan/Infiniti are vehicle makers that also have sectioning and full replacement procedures available. These companies also call out MIG/GMAW and RSW options in their procedures. Some procedures call for an open butt joint while other procedures require replacement at a factory joint. Conversely, Ford/Lincoln has limited sectioning procedures. In a position statement on sectioning, Ford says, "Sectioning can only be performed as per the workshop manual; otherwise, full replacement to a factory joint/seam is required." Many times, the choice between MIG/GMAW or STRSW may depend on access to the backside of the panel. This is because you cannot do single-sided RSW, due to lack of force and penetration. As you can see, there are many different procedures and recommendations, and this is just a very small sampling of the procedures available to the collision repair industry.

UsiBOR/Boron steel is a quenched AHSS/EHSS (Advanced or Extra High Strength Steel) that has a strength rating of 1000 MPa (145,037 psi) or higher. MIG/GMAW has a tensile strength of 70,000 psi (482.63 MPa). In most cases, the HAZ (Heat Affect Zone) of the MIG/GMAW will weaken the Boron and could cause it to react differently in a subsequent collision. For this reason, vehicle makers such as Audi, Mercedes Benz and BMW require very specific procedures for RSW and specific machines with the OEM parameters preinstalled for proper weld settings. Volvo is currently the only company we have found that allows MIG/GMAW and sectioning procedures for their rear body panel/bumper reinforcement on their SUV models, such as the XC90. Conversely, most OEMs require full part replacement. It is important to remember that just because one manufacturer allows a procedure, not all manufacturers will allow that same procedure.

Let's go over some procedures for setting up the welder and test welds:

- Check the replacement part and original part to ensure correct fit and position. Attach necessary brackets and confirm control point locations. Don't discard the shipping box until you have confirmed the panel is correct.

- Obtain the proper repair procedures from either the OEM or ALLDATA.

- Measure, measure, measure and measure again. Mark all the cut lines if applicable, and use masking tape to mark the area. A little "hot tip" is to put little arrows on the tape pointing towards the cut line so you remember which side to cut on. Believe me, this helps a lot.

- Go retrieve your MIG/GMAW, STRSW machines, rivet gun, adhesive, foams and any other applicable items. (i.e. welding wire recommended by vehicle manufacturer. It's no longer one size fits all.)

- Grab a fire extinguisher, a welding screen, some weld blankets and 3M Spark Paper.

- Ensure your work area is clean of any combustible material.

- Make sure you (or your technician) can see what they are welding and whether they need corrective lenses or a proper helmet. You can't make a weld if you can't see the weld.

Now, here's the fun part: Cut up some of the scrap pieces of material from the vehicle and set up the joint configurations and parameters you will be welding with on the vehicle, such as overhead, vertical and flat positions, open butt and butt with backing. You will also need to set up the root gap if required by the procedure. Now, make the welds and check the welds for the proper size and penetration. Once the pieces have cooled, perform a destructive test as per I-CAR or similar guidelines. Check the destructively tested welds for proper tear out and penetration. Write the date and repair order (RO) on all pieces and photograph them. The photos should be attached to the file, in case there is an issue later. These simple steps will help protect you from future liability. If you need to apply adhesives or preinstall foams, now is the time to do it. Recheck the set up of the replacement panels by measuring. This can be made easier if your shop has a JIG/Fixture system to hold parts in place, like the Car-o-liner EVO system or Celette Fixtures. Now, you are almost ready to weld the replacement parts in place.

Before striking the arc, you must consider heat management techniques, such as skipping around when welding. For example, when making plug welds, weld two plug welds, skip about four to eight and weld two. For resistance welding, weld four to five, skip four to eight and weld four to five. For seam welds on flange or butt joints with backing, weld a half-inch to three quarters of an inch, skip a half to three quarters and weld a half to three quarters. After some natural cooling, go back and fill in the welds. Never use compressed air to cool the welds, as you will crystallize the weld, which can result in cracking. You will also risk adding some moisture and oil from the air line. By staggering the weld location, heat concentration is reduced, which will limit panel distortion and metallurgical degradation of the material.

Until now, we have not questioned the abilities of the technician to make a proper weld. Are you or your welders certified? Are you participating in continuing education and taking qualification tests? Although most technicians and shop owners feel they are qualified welders, the majority are not. Ask any welding trainer, and they will tell you most collision welders do not wear the proper equipment and locate themselves in the wrong position. Most people can be trained to be a collision welder in a relatively short amount of time, and develop good skills with some practice. For training in welding, there are few good choices available. For example, the I-CAR Welding Qualification Test (WQT) in steel, aluminum and structural welding (although structural) is the only true test of your skill. The American Welding Society (AWS, at **www.aws.org**) offers many excellent courses in welding, although they do not offer any automotive grade steel certification testing. P&L Consultants (917-860-3588 for info) offers in-shop weld training in steel, aluminum, structural and STRSW, but they do not offer certification or qualification testing. Lew Kinney & Associates On-Site Welding Training & Certification (**www.lewkinney.com**) is part of the I-CAR Training Alliance and good for I-CAR Gold Class Points. Miller and Lincoln Welding Companies offer some good online welding information (**www.millerwelds.com**, **www.lincolnelectric.com**).

With some training and practice, you can make correct and proper welds. Do the research before you turn on the machine and put on the helmet. These days, weld prep includes knowing the recommended procedures and materials. Feel free to contact us at any time if you have any additional questions.

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