Open Butt Joint Welds

Many vehicle makers have collision repair procedures that call for open butt joints at sectioning locations for side apertures, quarter panels, rocker panels, and frame rails. Because of this, I-CAR is updating the Automotive Steel GMA (MIG) Welding Qualification Test (SWQT) to include this weld.

Joint Fit-Up

Let's examine what an open butt joint is and how it is welded. An open butt joint is made by butting two pieces that lie in the same plane, against each other with a gap of zero-to-one metal thicknesses between them (see Figure 1 over page). Butting the pieces tightly against each other makes them easier to weld, but also increases panel distortion. Even though the weld can be made with no root gap, it is best to have a small root gap to allow the metal to expand without placing it under stress that may weaken the joint and create distortion.

More than one method can be used to fit-up an open butt joint. Cut-lines can be measured and scribed on the panels (see Figure 2), or the cut-and-join method can be used. To do a cut-and-join open butt joint, the damaged panel and replacement panel are both cut longer than required. The replacement part is installed on the vehicle, overlapping the extra length left on the existing panel. A saw or cut-off wheel is then used to cut through both panels at the same time at the location of the joint (see Figure 3). This method leaves a root gap equal to the width of the saw blade or cut-off wheel.

Making the Weld

To weld an open butt joint, the welding gun is held at a 90° work angle. This points the electrode wire at the centre of the joint, allowing equal penetration into each piece (see Figure 4).

The weld can then be made using either the "push" or "pull" technique and a 70° travel angle (see Figure 5). The travel angle is the angle that the welding gun and electrode wire has to the base metal, either pointed toward or away from the direction of welding gun travel. The "pull" technique is when the welding gun and electrode wire are pointed at and dragged away from the weld puddle. The "push" technique is when the welding gun and electrode wire are both pointed and pushed away from the weld puddle. When comparing welds made using each technique, with all other parameters being the same, the "pull" technique produces a higher and narrower weld bead with increased penetration. The "push" technique makes a flatter wider bead with shallower penetration.

The weld can either be made continuously, or using the stitch or skip technique (see Figure 6). Making a series of short stitch welds may be helpful when welding thin material where the joint has a wide root gap. Which technique to use will depend on a number of variables including the technician's personal preference and welding style. Other variables include the thickness of the material being welded and the position of the joint on the vehicle.

Heat Management

Heat management is an important consideration when making open butt joint welds, as it is with all welds. The technique and welding machine settings should put only enough heat into the metal to achieve complete fusion and penetration of the pieces being welded. Make practice welds on the same type and thickness of metal, and in the same position that is to be welded on the vehicle. This will help determine the correct settings, technique, and other variables needed to make a good weld with the minimum of heat input.

This is especially important when welding on high-

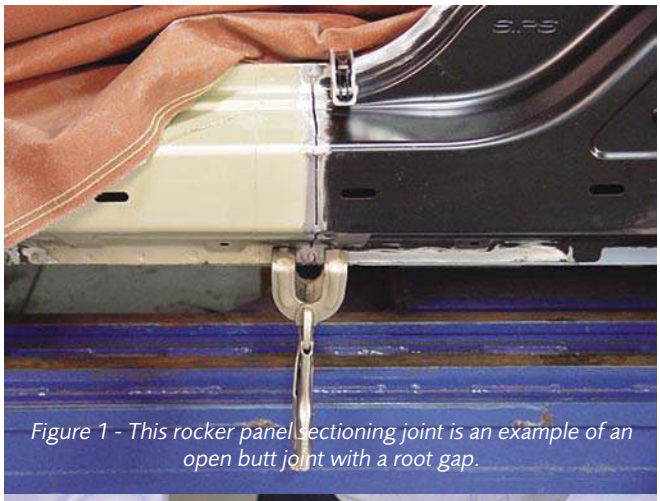

Figure 1 - This rocker panel sectioning joint is an example of an open butt joint with a root gap.

Figure 2 - This replacement B-pillar is being marked for the cut location for an open butt joint weld.

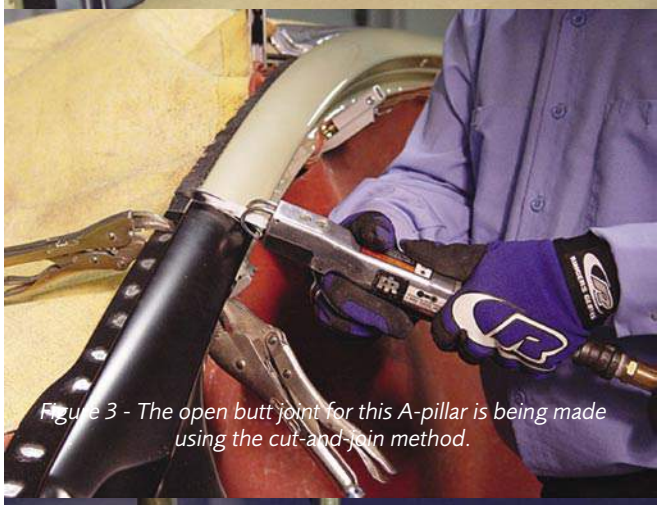

Figure 3 - The open butt joint for this A-pillar is being made using the cut-and-join method.

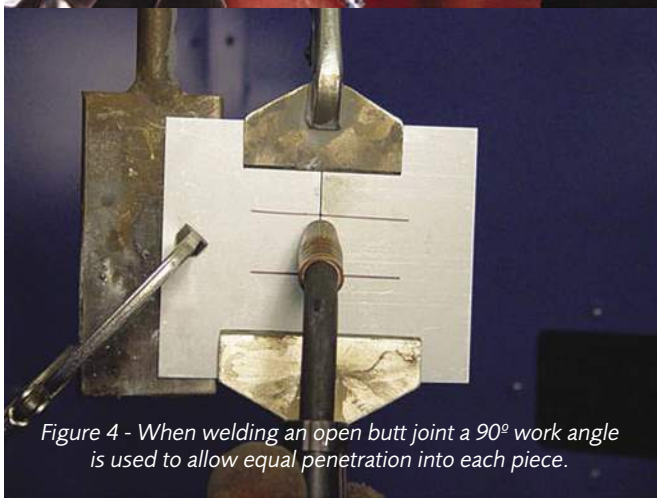

Figure 4 - When welding an open butt joint a 90º work angle is used to allow equal penetration into each piece.

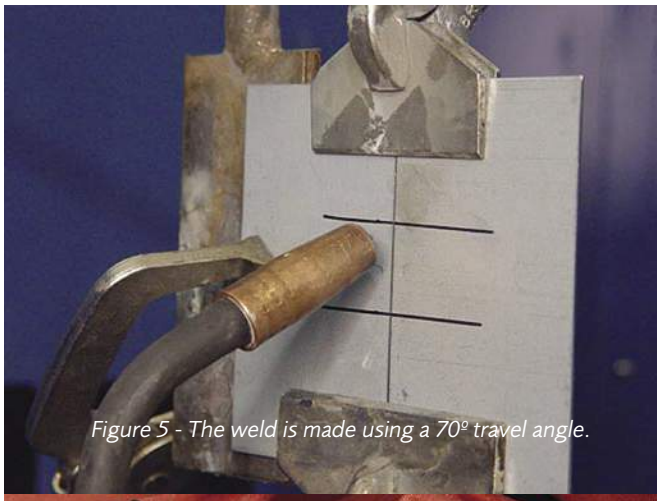

Figure 5 - The weld is made using a 70º travel angle.

Figure 6 - This series of short stitch welds was used to make an open butt joint weld.

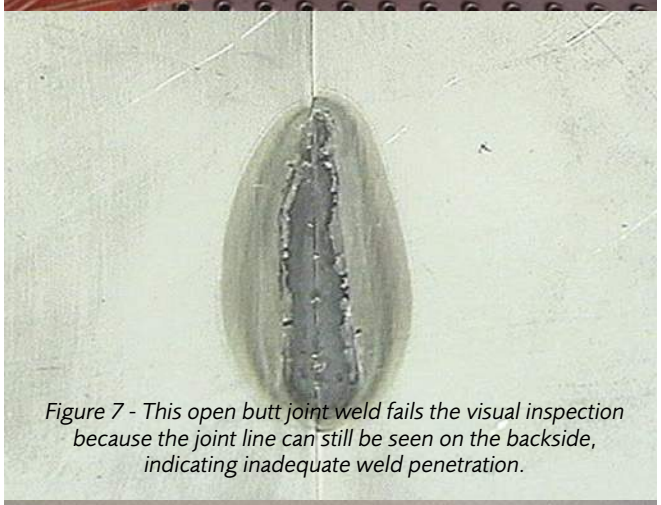

Figure 7 - This open butt joint weld fails the visual inspection because the joint line can still be seen on the backside, indicating inadequate weld penetration.

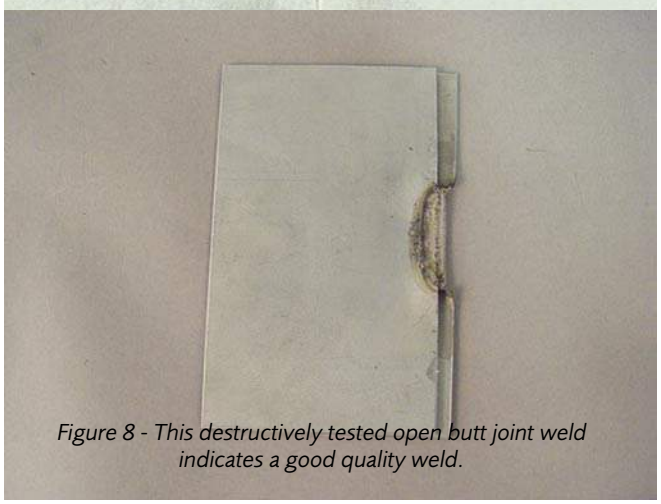

Figure 8 - This destructively tested open butt joint weld indicates a good quality weld.

strength steels and ultra-high-strength steels, as they may be significantly weakened by heat. Whenever welding on thin gauge material, use a stitch or skip technique in order to minimize panel distortion and reduce the chance of burnthrough.

Visual Inspection and Destructive Testing

After making practice welds they should be visually inspected and destructively tested. Visual signs of a good open butt joint weld include no cracks, porosity, or undercut of the weld bead. The joint must also be completely filled with no skips or voids in the weld bead. The backside of the joint must show evidence of complete penetration along the entire length of the weld. There should be melt-through that results in a ripple, and the line left by the joint must no longer be visible (see Figure 7). The melt-through height should not exceed 1.5 mm (1/16"), and there must be no burnthrough that creates a hole.

To destructively test an open butt joint weld, bend the pieces up toward each other with the bend on the weld joint. Have the root, or backside, of the weld on the face, or front side, of the bend (see Figure 8). Lightly hammer the sample flat and inspect the weld bead for cracks. The weld passes the destructive test if there are no cracks in the weld bead, or if any cracks detected show no visual signs of flaws, such as slag or porosity. Due to the severity of the test, cracks in the base metal outside of the weld bead are to be ignored. The weld fails the destructive test if the bead fractures completely apart, allowing the two pieces of the sample to separate.

Conclusion

Due to the increasing use by vehicle makers, the open butt joint will soon be added as one of the required welds in the I-CAR Automotive Steel GMA (MIG) Welding Qualification Test. The ability to make this weld and all welds properly when repairing a collision-damaged vehicle is one of the most important skills that a technician can have. Nothing plays a stronger role in the structural integrity of a repaired vehicle than the quality of the repair welds. Making test welds that are both visually inspected and destructively tested prior to welding on a vehicle is the only way to assure that the proper settings and techniques are being used.

Taking and passing the I-CAR Automotive Steel GMA (MIG) Welding Qualification Test shows that you are capable of making sound welds when repairing a vehicle. Soon, this test will include a requirement to make open butt joints in the vertical and overhead positions.

This article first appeared in the I-CAR Advantage Online, which is published and distributed free of charge. I-CAR, the Inter-Industry Conference on Auto Collision Repair, is a not-for-profit international training organization that researches and develops quality technical education programs related to collision repair. To learn more about I-CAR, and to subscribe to the free publication, visit http://www.i-car.com .