Uniform Procedures For Collision Repair UPCR

WE11S
GMA (MIG) Fillet Weld

 v.4.0

1. Description

This procedure describes methods for making and inspecting GMA (MIG) fillet welds on automotive steel.

2. Purpose

The purpose of this procedure is to provide industry-accepted requirements for performing high-quality fillet welds on steel. This procedure is intended for use by professionals who are qualified through training and experience.

3. Referenced Documents

The following documents are considered part of this procedure by reference.

3.1 Procedures

PS01 Personnel Safety

3.2 Other Information

Equipment-specific information
Vehicle-specific repair information

4. Equipment And Material Requirements

4.1 Shielding Gas

A shielding gas mixture of 75% argon and 25% CO_2 is recommended for GMA (MIG) welding automotive sheet steel. The flow rate is normally set at 25–30 cfh, or a pressure of 3–4 psi at the regulator. A higher rate may be required in the presence of a strong breeze.

4.2 Filler Wire

Filler wire must be compatible with the base metal being joined. These filler wires are recommended:

- ❏ AWS ER70S-6
- ❏ AWS ER70S-7

These wire diameters are recommended:

- ❏ 0.6 mm (.023") for 18–22 gauge steels
- ❏ 0.8 mm (.030") or 0.9 mm (.035") for 16 gauge and heavier, including frames

Flux-cored wire is not designed for steels thinner than 20 gauge and, therefore, is of limited use in collision repairs.

4.3 Transfer Mode

Short-circuit transfer is preferred for GMA (MIG) welding automotive sheet steel.

4.4 Polarity

Reverse polarity (electrode positive and base metal negative) is recommended for most collision repair welding.

4.5 Power Rating

Collision repair GMA (MIG) welders operate on either 110- or 220-volt, AC power. The thickness of the steel being welded determines how much amperage is needed. Generally, one amp is needed for every .025 mm (.001") of metal thickness (See table on following page).

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4. Equipment And Material Requirements (cont'd)

Gauge	Metal Thickness		Required Amps (1 amp/.001 thickness)
	mm	Inches	
8	4.2	.164	164
10	3.4	.135	135
12	2.7	.105	105
14	1.9	.075	75
16	1.5	.060	60
18	1.2	.048	48
20	0.9	.036	36
22	0.8	.030	30
24	0.6	.024	24

5. Damage Analysis

Does not apply.

6. Personnel Safety

6.1 General Safety

General safety information is in **PS01**.

6.2 Electric Shock

To prevent injury from electric shock:

- ❏ Set the welding machine following the equipment maker's instructions.
- ❏ Make sure cables and wires are in good condition.
- ❏ Make sure all connections are in good condition.
- ❏ Never place the welding machine in a wet area.
- ❏ Never stand in a wet area when welding.
- ❏ Never use the top of the welding machine as a table for food, etc.
- ❏ Inspect all welding machine plugs and receptacles before each use.
- ❏ Wear dry shoes or boots.

6.3 Arc Rays

To prevent eye injuries from ultraviolet exposure:

- ❏ Use a face helmet with a filter plate and clear safety lens cover.
- ❏ Use at least a grade 9 filter when welding at low amperage. A higher (darker) grade is recommended when welding current is above 60 amps.
- ❏ Say "cover" before striking an arc to alert others in the area.

6.4 Welding Fumes

To prevent injury from exposure to welding fumes:

- ❏ Wear an approved welding respirator.
- ❏ Use a welding fume extractor.
- ❏ Provide ventilation with a fan or other air circulator. A source of fresh air is necessary. However, do not point a fan directly at the weld site. This could blow away the shielding gas.

6.5 Sparks

To prevent burns from welding sparks:

- ❏ Wear safety glasses with side shields under the welding helmet.
- ❏ Wear protective clothing with long sleeves and no cuffs. Fasten shirt top button when welding.
- ❏ Wear leather gloves and welding sleeves.
- ❏ Do not touch hot metal or equipment.

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6. Personnel Safety (cont'd)

- ❏ Wear high-top leather shoes or boots.
- ❏ Make sure clothing and shoes are free from oil, grease, or other flammable materials.
- ❏ Remove all flammable materials from the area to be welded.
- ❏ Do not carry matches or butane lighters in pockets.
- ❏ Do not weld near parts containing fuel such as fuel tank, lines, pump, etc.
- ❏ Keep a fire extinguisher in the work area while welding.

7. Environmental Safety

Does not apply.

8. Vehicle Protection

8.1 Electronic Parts

To protect computers and other sensitive parts from damage:

- ❏ Follow the vehicle maker's recommendations for recording and resetting electronic memories.
- ❏ Ensure that the ignition switch is in the LOCK position, and the key is removed.
- ❏ Disconnect and isolate the negative battery cable, and disarm the passive restraint system. Follow the vehicle maker's recommendations.
- ❏ Carefully remove computer modules when welding or heating within 300 mm (12") or a greater distance when recommended by the vehicle maker.
- ❏ Protect modules, connectors, and wiring from dirt, heat, static electricity, and moisture.
- ❏ Loosen or remove any wiring harnesses or electrical parts that could be damaged during the repair process.

Remove the battery if it is near an area to be welded or heated.

8.2 Sparks

To protect surfaces from welding sparks:

- ❏ Use welding blankets on surfaces that can be covered.
- ❏ Remove interior trim, headliners, upholstery, and other parts if the interior will be exposed to sparks.

9. Repair Procedure

9.1 Fillet Welding Procedure

To make a GMA (MIG) fillet weld:

- ❏ 1. Clean the mating surfaces. Avoid removing any zinc coating.
- ❏ 2. Apply weld-through primer to all mating surfaces that do not have zinc coating or where the zinc coating was removed. Follow the vehicle maker's recommendations. Due to the poor adhesion property of some weld-through primers, it may have to be removed from all exposed surfaces after welding, before applying other coatings and sealants.
- ❏ 3. Clamp the mating surfaces tightly together.
- ❏ 4. Make test welds, before welding on the vehicle, using the same type and thickness metal that will be welded on the vehicle. Make the test welds in the same position as the welds on the vehicle, using weld-through primer if applicable. See **11.1**.
- ❏ 5. Visually inspect and destructively test the welds to verify the welder settings and the welding technique. See **11.2** and **11.3**.
- ❏ 6. Locate the work clamp as close to the welding site as possible.
- ❏ 7. Make the welds on the vehicle.
- ❏ 8. Dress the welds, if necessary. Do not reduce the thickness of the surrounding sheet metal or remove any zinc coating.

10. Use Of Recycled (Salvage) Parts

10.1 Preparation Of Salvage Parts

To prepare salvage parts for welding:

- ❏ Trim the parts to fit.
- ❏ Remove all heat-affected zones.
- ❏ Make sure the parts are not deformed along the weld joints to ensure proper fit-up.
- ❏ Make sure mating surfaces are clean. Avoid removing any zinc coating.

11. Inspection And Testing

11.1 Test Welds

Make test welds, before welding on the vehicle, using the same type and thickness metal that will be welded on the vehicle. Make the test welds in the same position as the welds on the vehicle, using weld-through primer if applicable. Visually inspect and destructively test the welds before welding on the vehicle.

Make the test welds on small pieces of flat scrap steel, trimmed to about 75 x 125 mm (3 x 5"). Damaged parts that are to be replaced may provide scrap pieces. Lap two pieces together halfway, and make a single fillet weld 30–40 mm ($1\frac{1}{4}$–$1\frac{1}{2}$") long in the center of each sample.

11.2 Visual Inspection

The following visual inspection requirements for bead height, width, and penetration are for 18–20 gauge steel. The requirements will change slightly for other steel thicknesses.

The face of the fillet weld must meet these requirements:

- ❏ no cracks
- ❏ no porosity, skips, or voids
- ❏ no undercut
- ❏ joint completely filled
- ❏ bead height no greater than 3 mm ($\frac{1}{8}$")
- ❏ bead width 5–10 mm ($\frac{3}{16}$–$\frac{3}{8}$")

The back side of the fillet weld must meet these requirements:

- ❏ no burnthrough
- ❏ evidence of penetration
- ❏ penetration width no greater than 5 mm ($\frac{3}{16}$")
- ❏ penetration extending no more than 1.5 mm ($\frac{1}{16}$") from the bottom

The fillet weld is a failure if any of these requirements are not met.

11.3 Destructive Tests

Test the sample welds using this procedure:

- ❏ 1. Secure the bottom piece in a vise with the fillet weld facing the front.
- ❏ 2. Use both hands to rock the top piece back and forth until it breaks free from the bottom piece.
- ❏ 3. The weld is good only if there is continuous fusion between the pieces along the full length of the weld. Evidence of fusion is metal pulling out of the top piece and the weld still holding firm. A very small void, due to a cold start, is permissible at the beginning of the weld.