

Uniform Procedures For Collision Repair

WE01S—GMA (MIG) Plug Weld

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v.2.4



1. Description

This procedure describes methods for making and evaluating GMA (MIG) **plug welds** on all types of automotive steel.



2. Purpose

The purpose of this procedure is to provide industry-accepted requirements for performing high-quality plug 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% **CO₂** is recommended for **GMA (MIG) welding** automotive sheet steel. The flow rate is normally set at 25–30 **cfh**, or 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 the preferred mode for GMA (MIG) welding automotive sheet steel.

4.4 Polarity

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

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6. Personnel Safety (cont'd)

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 leather cape welding sleeves.
- Do not touch hot metal or equipment.
- 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 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.

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8. Vehicle Protection (cont'd)

- ❑ 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 Plug Welding Procedure

To make a GMA (MIG) plug weld:

- ❑ 1. Clean the mating surfaces. Avoid removing any **zinc coating**.
- ❑ 2. Refer to the vehicle maker's recommendation for the location, number, and size of plug weld holes. If no recommendations are available, punch or drill 8 mm ($5/16$ ") holes in the outer panel at the same locations used originally by the vehicle maker. When plug welds are used to join three or more panels, punch or drill holes in every piece except the base piece. Make the holes progressively smaller from the outer to the base piece.
- ❑ 3. Apply **weld-through primer** to all weld 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.
- ❑ 4. Clamp the mating surfaces tightly together.
- ❑ 5. 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**.
- ❑ 6. Visually inspect and **destructively test** the welds to verify the welder settings and the welding technique. See **11.2** and **11.3**.

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9. Repair Procedure (cont'd)

- 7. Locate the work clamp as close to the welding site as possible.
- 8. Make the welds on the vehicle.
- 9. 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. Weld two pieces together at right angles, using a single plug weld for each sample.

11.2 Visual Inspection

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

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11. Inspection And Testing (cont'd)

The face of the plug weld must meet these requirements:

- no cracks
- no **porosity**, skips, or voids
- no **undercut**
- hole completely filled
- nugget height no greater than 3 mm ($\frac{1}{8}$ ")
- nugget diameter between 10–13 mm ($\frac{3}{8}$ – $\frac{1}{2}$ ")

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

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

The plug 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.
2. Use both hands or a locking pliers to twist the top piece off the bottom piece. Keep the faces parallel.
3. Measure the diameter of the nugget hole left in the bottom piece. The plug weld is good if the nugget hole is at least 5 mm ($\frac{3}{16}$ ").

