



SP11A

Frame

**Uniform
Procedures For
Collision Repair
UPCR**

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v.4.0



1. Description

This procedure describes the repair and complete or partial replacement of an aluminum frame on a body-on-frame vehicle. Inspection and evaluation requirements are also included.



2. Purpose

The purpose of this procedure is to provide industry-accepted requirements for performing high-quality repair of aluminum frames. 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

- CP01A Corrosion Protection
- ME01 Three-Dimensional Measuring
- PS01 Personnel Safety
- RF41 Finish Application
- ST01A Stress-Relieving Heat Limitations
- ST11 Structural Straightening
- ST21A Metal Repair
- WA01 Wheel Alignment, Front
- WA11 Wheel Alignment, Rear
- WE11A GMA (MIG) Fillet Weld
- WE21A GMA (MIG) Butt Joint With Backing

3.2 Other Information

- Equipment-specific information
- Product-specific information
- Vehicle-specific dimension specifications
- Vehicle-specific repair information



4. Equipment And Material Requirements

4.1 Welding Equipment

Use GMA (MIG) welding equipment as described in **WE11A** or **WE21A**.

4.2 Welding Filler Wire

Welding filler wire must be compatible with the base metal alloy being joined. See **WE11A** or **WE21A**.

A filler wire thickness of 1.1 mm (.045") or thicker is generally required for aluminum full frames. Follow the vehicle maker's recommendations.

4.3 Straightening And Measuring Equipment

Use straightening equipment as described in **ST11**.

Use measuring equipment as described in **ME01**.

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4. Equipment And Material Requirements (cont'd)

4.4 Special Equipment

Use tools and materials, such as abrasives, that are designated for use only on aluminum, to avoid surface contamination.

A stainless steel wire brush, dedicated for use on aluminum, is recommended for cleaning aluminum before making a weld.

A power saw is recommended for cutting aluminum parts for partial replacement.



5. Damage Analysis

5.1 General Damage

Inspect an aluminum frame for these types of damage:

- visible damage
- corrosion
- dimensional misalignment
- improper previous repairs

5.2 Mounting Locations

Inspect an aluminum frame for damage at mounting locations such as these:

- radiator core support
- engine
- suspension
- fuel system
- brake system
- exhaust system
- body mounting surfaces
- bumpers

Determine how much of the frame assembly can be straightened, and the portion that must be replaced. Some vehicle makers recommend only full replacement of a damaged frame, while others allow sectioning a frame, if it can be returned to its proper dimensional shape. Verify the availability of replacement parts. Follow the vehicle maker's recommendations for joint locations.

If a replacement rail extension will be used, follow the vehicle maker's replacement procedure.

Note: Some vehicle makers recommend against welding tears in aluminum alloys.



6. Personnel Safety

6.1 General Safety

General safety information is in **PS01**.

6.2 Pulling Safety

Pulling safety information is in **ST11**.

6.3 Welding Safety

Welding safety information is in **WE11A** or **WE21A**.

6.4 Safety With Power Tools And Electrical Equipment

Power tool and electrical equipment safety information is in **ST21A**.



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 computer modules, connectors, and wiring from contamination such as dirt, heat, static electricity, and moisture.
- Loosen or remove any wiring harnesses or electrical parts that could be damaged during the repair process.
- Remove any electronic modules that may be subject to impact during the repair procedure.

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

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8. Vehicle Protection (cont'd)

8.2 Adjacent Areas

Protect glass, upholstery, and other cosmetic surfaces from welding and cutting sparks. Remove interior trim and adjacent parts that cannot be protected.

Remove or relocate any wiring, brake lines, or other parts that may be attached to, or routed through the frame rails.

8.3 Aluminum Surfaces

To prevent damaging aluminum surfaces:

- Use an orbital or dual-action sander. Do not use a disc grinder.
- Use 80-grit or finer, open-coat sanding discs.
- Use foam backing pads instead of stiff backing pads.
- Apply less pressure than when sanding steel.
- Do not sand continuously in the same area.
- Keep sanding discs and other abrasives separate from those used for steel repairs.
- Make sure the faces and edges of metal hammers and dollies are smooth and polished and have rounded edges.
- Make sure the points of picks are not sharp. File or grind the tips until they are rounded or flat. An option is to use a tip made of rubber or plastic, or cover the tip with tape.
- Use a dull file.
- Do not use shrinking hammers.

8.4 Galvanic Corrosion

Avoid galvanic corrosion of aluminum parts by following the procedures in **CP01A**.

To prevent galvanic corrosion when straightening aluminum parts:

- Ensure that all tools are cleaned before, or are dedicated for, use on aluminum.
- Thoroughly remove steel particles from power tools before use.
- Keep hand tools separate from those used for steel repairs.
- Keep sanding discs and other abrasives separate from those used for steel repairs.

8.5 Use Of Heat

The improper application of heat on aluminum alloys can greatly affect their strength. To prevent permanent softening, or increasing brittleness, of certain alloys, the temperature and heating time must be strictly controlled. Follow the vehicle maker's recommendations for applying heat to aluminum parts.

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8. Vehicle Protection (cont'd)

If vehicle maker recommendations are not available, keep the repair temperature between 200°C (400°F) and 300°C (570°F), while limiting the total heating time to no more than 15 minutes. Use temperature-measuring methods as described in **ST01A**.

Note: Some vehicle makers recommend against the use of heat on certain parts.



9. Repair Procedure

9.1 Straightening

To straighten an aluminum frame:

- 1. Reposition or remove any attached mechanical or electrical parts required for access or to prevent damage.
- 2. Thoroughly clean the repair area to remove dirt, grease, sealers, anti-corrosion materials, etc.
- 3. Make sure the vehicle is properly anchored to the straightening system.
- 4. Make underbody and upperbody measurements using a three-dimensional measuring system to determine the extent of damage.
- 5. Use multiple pulls and heat, if needed, to return the damaged area to its proper shape and location. Follow the repair and tolerance recommendations of the vehicle maker. If no recommendations are given, use a tolerance of ± 5 mm ($\frac{3}{16}$ "). Use a three-dimensional measuring system to verify that the frame is properly aligned.
Note: If heat is used, follow the vehicle maker's temperature and time recommendations. Some vehicle makers recommend against the use of heat on certain parts. Refer to the vehicle maker's repair information to locate any foam-fillers or wiring before applying heat.
- 6. Replace any areas that are kinked, have stress cracks, or develop cracks during straightening. Some vehicle makers recommend against welding tears in aluminum alloys. Use a dye penetrant to check the damaged area for cracks. If complete replacement is required, see **9.2**. For sectioning, see **9.3** and **9.4**.
- 7. Apply corrosion-resistant primer to areas damaged by the collision, repairs, or anchoring.
- 8. Apply seam sealers, if required, to seal the joints and restore the appearance. Reprime if required by the product maker.
- 9. Apply anti-corrosion compounds to enclosed areas, if required.
- 10. Refinish areas damaged by the collision, repairs, or anchoring, if required to restore the appearance.
- 11. Transfer or install replacement mechanical or electrical parts previously removed. Include spacers, washers, isolators, etc. required to prevent contact between dissimilar metals.
- 12. Continue vehicle reassembly.

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9. Repair Procedure (cont'd)

9.2 Complete Replacement

To remove and replace an aluminum full frame:

- 1. Properly support and prepare the replacement frame. Follow the vehicle maker's recommendations.
- 2. Apply corrosion-resistant primer to all areas, if required.
- 3. Apply anti-corrosion compounds to all enclosed areas, if required.
- 4. Refinish to restore the appearance, if required.
- 5. Mark and disconnect hoses, wiring, etc., from the drivetrain.
- 6. Loosen and remove the fasteners holding the body sections to the frame.
- 7. Remove and properly store the body sections.
- 8. Systematically transfer all undamaged suspension and drivetrain parts from the original frame to the replacement frame. Replace any damaged parts. Follow the vehicle maker's recommendations for replacing fasteners. Use the proper spacers, washers, isolators, etc., required to prevent contact between dissimilar metals. See **8.4**.
- 9. Repair or replace damaged body sections, including frame mounting areas. Use the proper spacers, washers, isolators, etc., required to prevent contact between dissimilar metals.
- 10. Remount body sections, replacing same size, shape, and strength mounting pads and fasteners if required. Use the proper spacers, washers, isolators, etc., required to prevent contact between dissimilar metals. Torque fasteners to the vehicle maker's recommendations.
- 11. Align the body sections to ensure proper and even gaps.
- 12. Continue vehicle reassembly.

9.3. Partial Removal

Note: Some vehicle makers allow sectioning an aluminum frame only in specific areas.

To remove the damaged portion of an aluminum frame for partial replacement:

- 1. Reposition or remove any attached mechanical or electrical parts required for access or to prevent damage.
- 2. Thoroughly clean the repair area to remove dirt, grease, sealers, anti-corrosion materials, etc.
- 3. Perform measurements and frame alignment and straightening. See **9.1**.
- 4. Select the cut locations based on the repair procedure.
- 5. Measure and mark the cut locations.
- 6. Cut the undamaged portion of the frame slightly longer than the final cut location, using a saw. Do not damage the parts that are attached to the damaged section if they are not to be replaced.
- 7. Remove the damaged portion of the frame from the vehicle.
- 8. Trim the remaining edges of the frame to the exact cut locations.

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9. Repair Procedure (cont'd)

- 9. Remove all burrs from the mating surfaces.
- 10. Straighten the frame edges, if required to ensure a proper fit-up with the replacement portion.

9.4 Partial Installation

To install an aluminum partial frame section:

- 1. Compare the replacement part to the original part by part number, visual inspection, and measuring. Measure across the area to be sectioned using three or more reference points, such as holes, notches, weld seams, or feature lines. If no reference points exist on the replacement part, make reference marks on both parts.
- 2. Cut the replacement frame section to the proper length and shape for the type of joint recommended by the vehicle maker. The type of joint selected may require the use of an insert.
- 3. Clean the mating surfaces with the proper surface cleaner.
- 4. Use a stainless steel brush, designated for use on aluminum only, to remove aluminum oxide from the weld locations. Do not touch cleaned areas.
- 5. Follow the vehicle maker's recommendations for welding. Some vehicle makers require beveling the mating surfaces to allow better weld penetration.
- 6. Test-fit and align the replacement frame section, and clamp it in place.
- 7. Use a three-dimensional measuring system to verify that the partial frame section is properly aligned.
- 8. Tack weld, or securely hold, the frame section in position. Ensure that the proper electrode wire is being used for the type of alloy being welded.
- 9. Recheck the alignment.
- 10. Install any rivets, following the vehicle maker's recommendations.
- 11. 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. Visually inspect and destructively test the welds before welding on the vehicle.
- 12. Make the required welds. Make all welds as long as possible, without causing heat distortion, to avoid start and stop defects. Use a dye penetrant to check the welds for cracks, only if recommended by the vehicle maker. Correct any defects.
- 13. Use the three-dimensional measuring system to verify that the frame is still properly aligned.
- 14. Dress the welds, if required to restore the appearance.
- 15. Apply corrosion-resistant primer to interior and exterior surfaces damaged by the collision, repairs, or anchoring.
- 16. Apply seam sealers, if required to seal the joints and restore the appearance. Reprime if required by the product maker.
- 17. Apply anti-corrosion compounds to enclosed areas, if required.
- 18. Refinish areas damaged by the collision, repairs, or anchoring, if required to restore the appearance.

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9. Repair Procedure (cont'd)

- 19. Transfer or install replacement mechanical or electrical parts previously removed. Include spacers, washers, isolators, etc. required to prevent contact between dissimilar metals.
- 20. Replace any damaged suspension or drivetrain parts. Follow the vehicle maker's recommendations on replacing fasteners.
- 21. Repair or replace body sections, if required, including frame mounting areas.
- 22. Remount body sections, replacing mounting pads and fasteners, if required.
- 23. Align the body sections to ensure proper and even gaps.
- 24. Continue vehicle reassembly.



10. Use Of Recycled (Salvage) Parts

10.1 Inspection Of Salvage Parts

Do not install a salvage aluminum frame, or frame section, having any of these defects:

- unrepairable damage
- corrosion that has caused pitting
- improper previous repairs
- extra, non-original holes, slots, or brackets
- missing or damaged mounting locations

10.2 Preparation Of Salvage Parts

To prepare a salvage frame, or frame section, for installation:

- Make any required repairs.
- Trim the part to fit.
- Remove all heat-affected zones.
- Make sure the part is not deformed along the weld joints.
- Remove any corrosion.



11. Inspection And Testing

11.1 Inspection Of A Repaired Or Replaced Frame

Inspect a repaired or replaced aluminum frame for these conditions:

- dimensional alignment
- weld quality
- proper application of corrosion protection
- proper finish appearance and film thickness
- proper alignment and operation of all body panels
- proper installation of all labels
- proper installation of seam sealers
- proper installation of sound-deadening materials
- proper installation, alignment, and operation of all attached mechanical and electrical parts
- proper installation of any spacers, washers, isolators, etc., required to prevent contact between dissimilar metals

Correct any defects.

The front and rear wheel alignment should be checked, after repairing or replacing a frame, to determine if re-alignment is required.