

Uniform Procedures For Collision Repair

SP11S-Frame

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v.3.2



1. Description

This procedure describes the repair and complete or partial replacement of a steel 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 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

- CP01S Corrosion Protection
- ME01 Three-Dimensional Measuring
- PS01 Personnel Safety
- RF01S Surface Preparation
- RF41 Finish Application
- ST01S Stress-Relieving Heat Limitations
- ST11 Structural Straightening
- WE11S GMA (MIG) Fillet Weld
- WE21S GMA (MIG) Butt Joint With Backing

3.2 Other Information

- Vehicle-specific dimension specifications
- Vehicle-specific repair information



4. Equipment And Material Requirements

4.1 Straightening And Measuring Equipment

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

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

4.2 Welding Equipment

Use GMA (MIG) welding equipment as described in **WE11S** or **WE21S**.



5. Damage Analysis

5.1 General Damage

Inspect a frame for these types of damage:

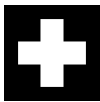
- visible damage
- corrosion
- improper previous repairs
- dimensional misalignment

Determine how much of the frame assembly can be straightened, and the portion that must be replaced. Verify the availability of replacement parts. Some vehicle makers recommend only full replacement of damaged frame assemblies. Refer to the vehicle maker's **body repair manual** for recommended joint locations.

5.2 Adjacent Areas

Inspect adjacent areas for these conditions:

- mechanical parts that must be removed or replaced
- damage to body mounting surfaces



6. Personnel Safety

6.1 General Safety

General safety information is in **PS01**.

6.2 Straightening Safety

Straightening safety information is in **ST11**.

6.3 Welding Safety

Welding safety information is in **WE11S** or **WE21S**.



7. Environmental Safety

Does not apply.



8. Vehicle Protection

8.1 Stress-Relieving

If heat is used for stress-relieving, use temperature-measuring methods as described in **ST01S**.

Note: Some vehicle makers recommend against the use of heat for stress-relieving.

8.2 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.

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8. Vehicle Protection (cont'd)

- Protect computer 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 in an area to be welded or heated.

8.3 Adjacent Areas

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

8.4 Sectioning Guidelines

Do not section in or near these areas:

- holes larger than 3 mm (1/8")
- compound shapes** or structures
- areas where proper welding cannot be performed
- collapse or crush zones
- mechanical part-mounting locations

Note: Do not section inner reinforcements unless recommended by the vehicle maker.



9. Repair Procedure

9.1 Straightening

To straighten a frame:

1. Make sure the vehicle is properly anchored to the straightening system.
2. Make underbody measurements to determine the location of the frame.
3. Use **multiple pulls** and stress-relieving 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 ($3/16$ "). Use a **three-dimensional measuring system** and adjacent panels to verify that the part is properly aligned.

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9. Repair Procedure (cont'd)

- 4. If heat is used for relieving stress, follow the vehicle maker's temperature and time recommendations.
Note: Some vehicle makers recommend against the use of heat for stress-relieving.
- 5. If a part is **kinked**, has stress cracks, or develops cracks during straightening, follow the vehicle maker's repair procedure. If no repair procedure is specified, replace the part. See **9.2**, **9.3**, or **9.4**.
- 6. Apply corrosion-resistant primer to all interior and exterior surfaces damaged by the collision, repairs, or anchoring.
- 7. Apply **seam sealers**, as necessary, to seal the joints and restore the appearance. Reprime if required by the product maker.
- 8. Apply **anti-corrosion compounds** to all enclosed areas.
- 9. Refinish areas damaged by the collision, repairs, or anchoring, as required to restore the appearance. Refinish cosmetic surfaces after all body repairs are complete.
- 10. Continue vehicle reassembly.

Note: Some vehicle makers allow sectioning a frame, if it can be returned to its proper dimensional shape.

9.2 Full Frame Replacement

To remove and replace a full frame:

- 1. Perform underbody measurements and adjacent panel alignment and straightening. See **9.1**.
- 2. Mark and disconnect hoses, wiring, etc., from the powertrain.
- 3. Loosen and remove the fasteners holding the body sections to the frame.
- 4. Remove body sections.
- 5. 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.
- 6. Repair or replace body sections as necessary, including frame mounting areas.
- 7. Remount body sections, replacing same size, shape, and strength mounting pads and fasteners as necessary. Torque fasteners to the vehicle maker's recommendations.
- 8. Align the body sections to ensure proper and even gaps. Adjust as necessary.
- 9. Apply corrosion-resistant primer to all interior and exterior surfaces damaged by the collision, repairs, or anchoring.
- 10. Apply anti-corrosion compounds to all enclosed areas.

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9. Repair Procedure (cont'd)

- ❑ 11. Refinish areas damaged by the collision, repairs, or anchoring, as required to restore the appearance. Refinish cosmetic surfaces after all body repairs are complete.
- ❑ 12. Continue vehicle reassembly.

9.3 Partial Frame Removal

Note: Some vehicle makers recommend full-frame replacement only.

To remove the damaged portion of a frame for partial replacement:

- ❑ 1. Perform underbody measurements and adjacent panel alignment and straightening. See 9.1.
- ❑ 2. Select the cut locations based on the damage and construction of the frame. Follow the vehicle maker's recommendations and the sectioning location guidelines described in 8.4.
- ❑ 3. Measure and mark the cut locations.
- ❑ 4. Cut the undamaged portion of the frame slightly longer than the final cut locations. Avoid creating a large **heat-affected zone**.
- ❑ 5. Remove the damaged portion of the frame from the vehicle.
- ❑ 6. Trim the remaining edges of the frame to the exact cut locations.
- ❑ 7. Remove all burrs from the mating surfaces. Avoid removing any **zinc coating**.
- ❑ 8. Straighten the frame edges, if necessary to ensure a proper fit-up with the replacement portion.

9.4 Partial Frame Installation

To install a replacement frame section:

- ❑ 1. Compare the replacement part to the original part by 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 locations exist on the replacement part, make **reference points** on both parts.
- ❑ 2. Cut the replacement frame section to the proper length and shape for the type of joints recommended by the vehicle maker.
- ❑ 3. Clean the mating surfaces. Avoid removing any zinc coating.
- ❑ 4. Refer to the vehicle maker's body repair manual for the recommended welding method. Some vehicle makers may require grinding a **bevel** on the mating surfaces to allow for better weld penetration.
- ❑ 5. Test-fit and align the replacement frame section, and clamp it in place.

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9. Repair Procedure (cont'd)

- 6. Remove the frame section from the vehicle.
- 7. 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.
- 8. Position the replacement part on the vehicle and clamp it in place.
- 9. Use a three-dimensional measuring system and adjacent panels to verify that the part is properly aligned.
- 10. 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.
- 11. **Tack weld**, or securely hold, the part in position.
- 12. Recheck the alignment using the measuring system and the adjacent panels.
- 13. Make the required welds.
- 14. Use the measuring system and adjacent panels to verify that the frame is still properly aligned.
- 15. **Dress the welds**, if necessary.
- 16. Replace any damaged suspension or drivetrain parts. Follow the vehicle maker's recommendations on replacing fasteners.
- 17. Repair or replace body sections as necessary, including frame mounting areas.
- 18. Remount body sections, replacing mounting pads and fasteners as necessary.
- 19. Align the body sections to ensure proper and even gaps. Adjust as necessary.
- 20. Apply corrosion-resistant primer to all interior and exterior surfaces damaged by the collision, repairs, or anchoring.
- 21. Apply anti-corrosion compounds to all enclosed areas.
- 22. Refinish areas damaged by the collision, repairs, or anchoring, as required to restore the appearance. Refinish cosmetic surfaces after all body repairs are complete.
- 23. Continue vehicle reassembly.

9.5 Riveted-On Part Replacement

Replace rivets with either bolts, nuts and washers, or rivets. Follow the vehicle maker's recommendations. When replacing rivets with bolts, install the next larger size diameter bolt to assure proper fit. Use at least a grade-5 fastener. (See chart on page 9)

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9. Repair Procedure (cont'd)

Type Or Grade	Headmark	Material	Heat Treat	Minimum Tensile Strength
10.9 Metric		STD. Alloy Steel	STD. Quench & Tempered	1040 MPa (150,800 psi)
SAE Grade 8		Med. Carbon or STD. alloy through 7/16"	STD. Quench & Tempered above 7/16"	150,000 psi
9.8 Metric		Med. Carbon Steel	STD. Quench & Tempered	900 MPa (130,500 psi)
8.8 Metric		Med. Carbon Steel	STD. Quench & Tempered	830 MPa (120,350 psi)
SAE Grade 5		Med. Carbon Steel	STD. Quench & Tempered	120,000 psi
5.8 Metric		Med. or Low Carbon Steel	Non-Heat Treated	520 MPa (75,400 psi)
SAE Grade 2	 (No Mark)	Med. or Low Carbon Steel	Non-Heat Treated	74,000 psi

To replace a damaged part that is riveted to the frame:

1. Drill a pilot hole through the rivet.
2. Redrill the hole through the shank of the rivet.
3. Remove the rivet head.
4. Drive out the rivet.
5. Remove the damaged part from the frame.
6. Position the replacement part on the frame and clamp it in place.
7. Use a three-dimensional measuring system and adjacent panels to verify that the part is properly aligned.
8. Drill the hole through the frame and the part to the diameter of the fastener that will be used.
9. Install the bolt or rivet. If using a bolt, torque to the vehicle maker's recommendations.
10. Use the measuring system and adjacent panels to verify that the part is still properly aligned.

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9. Repair Procedure (cont'd)

- 11. If using a bolt, tack weld the nut to the bolt or use a thread-locking compound. Follow the vehicle maker's recommendations.
- 12. Apply corrosion-resistant primer to all interior and exterior surfaces damaged by the collision, repairs, or anchoring.
- 13. Apply anti-corrosion compounds to all enclosed areas.
- 14. Refinish areas damaged by the collision, repairs, or anchoring, as required to restore the appearance. Refinish cosmetic areas after all body repairs are complete.
- 15. Continue vehicle reassembly.



10. Use Of Recycled (Salvage) Parts

10.1 Inspection Of **Salvage Parts**

Do not install a salvage frame part having any of these defects:

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

10.2 Preparation Of Salvage Parts

To prepare a salvage frame part for installation:

- Clean the part to remove dirt, wax, grease, undercoatings, corrosion, etc.
- Remove all heat-affected zones.
- Trim the part to fit.
- Make sure the part is not deformed along the mating surfaces.



11. Inspection And Testing

11.1 Inspection Of A Repaired Or Replaced Frame

Inspect a repaired or replaced frame for these conditions:

- dimensional alignment
- proper finish appearance and film thickness
- proper application of corrosion protection
- proper alignment and operation of body panels
- proper installation, alignment, and operation of all attached mechanical parts

Correct any defects.

A suspension alignment is required after repairing or replacing a frame.