



Body Structure Seat Anchorage Durability

1 Scope

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The purpose of this procedure is to evaluate the structural durability of the body structure seat attachments, and to validate the body Subsystem Technical Specifications (SSTS) requirements. The body structure shall support the interface load from the durability schedule of the seatback/frame with no loss of function when tested in accordance to the seat frame loads based durability test.

1.2 Foreword. This procedure was developed to simulate actual customer usage, and to evaluate the durability of the seat attachment into the body structure.

1.3 Applicability. This test shall apply to GM passenger cars, Sport Utility Vehicles (SUV), vans and light duty trucks. This procedure applies to front, rear, and third row seats, or fourth if applicable, that are considered "Free-Standing" seats. Free Standing for purposes of this procedure can be described as those seats that are not supported by surrounding structure, and include both single occupant, and multiple occupant seats that are sometimes known as bench seats. More specifically, multiple occupant seats can provide seating positions for two or more passengers. For seats providing positions of three or more occupants, the load applied to the seat may be redistributed so that one half of the total load on the seat is placed in each of the two outboard locations.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14048

2.3 Additional References.

Body Structures SSTS (Subsystem Technical Specifications)

CG190 Evaluation Report Template

CG583 Development/Validation Test and Vehicle Review

Test Fixture Design Number TLA-00258

3 Resources

3.1 Facilities. A GM test lab or similarly equipped facility.

3.1.1 Minor Facility.

3.1.1.1 Bedplate and Surrounding Area. Approximately 4 m (length) x 4 m (width) of bedplate space is needed, depending on the length and width of the body structure and size and placement of the actuators.

3.1.1.2 Overhead Crane. An overhead crane (or other lifting device) of sufficient capacity to lift the body structure and allow installation onto bedplate.

3.1.1.3 Hydraulic System. The system should be capable of supplying pressurized oil at a sufficient flow rate to meet the maximum simulator system demand. Typically, the system should be capable of delivering

approximately 3.8 L/minute at 21 MPa. The load input equipment may include one or more single loop hydraulic actuators or one or more multi axis actuators.

3.2 Equipment. Reference photos are found in Appendix A.

Note: The following list(s) include fixtures and instrumentation typically used to perform this test. Other equipment may be substituted at the discretion of the testing facility as long as it provides the same data and/or data record with equivalent accuracy as specified herein or by the requestor.

3.2.1 A variety of software can be used to prepare actual time history data for use. This procedure will not specify the preferred data software because that technology frequently changes.

3.2.2 Fixture. A seat frame with reinforcements which is capable of applying repetitive cycling of separate loads at varying heights, angles, and magnitudes.

3.2.3 Cylinders. Hydraulic cylinders with appropriate valves for predictable control of input forces.

3.2.4 Load Control Device. A system used to control the amount of load applied to the seat back and bottom. The system shall be capable of applying the loads specified in 4.3.4.

3.2.5 Load Application Device. Actuators with a minimum load capacity of 3000 N each and connections to the seat and back pan so that seat and backrest can be loaded simultaneously.

3.2.6 Load Cell. A load cell with 3000 N capacity or equivalent for measuring applied load to seat and back.

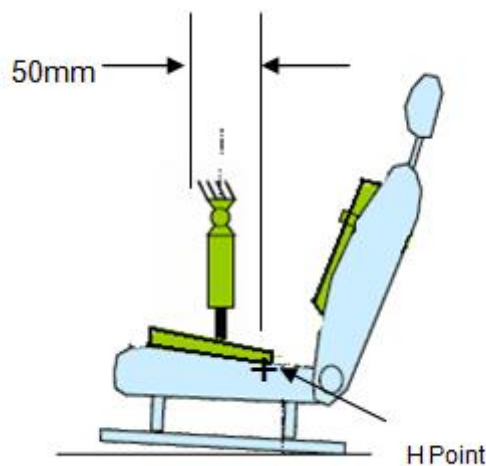


Figure 1: Seat Cushion Actuator Direction

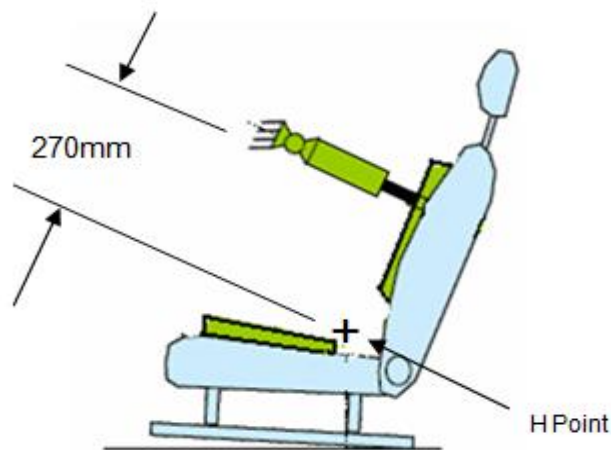


Figure 2: Seat Back Actuator Direction

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3.2.7. Cycling Phase. Note that some cycles listed in 4.3.4 are to be run separately. That is, the seat cushion load is to be cycled while the seat back load is not being cycled and vice versa. Other cycles call for cycling the seat and cushion loads simultaneously. When cycling simultaneously, the loads should be applied at the same frequency, but 180 degrees out of phase (i.e., the seat cushion load should be peaking while the seat back load is approaching zero and vice versa).

3.2.8. Seat Back Frame Angle Measurement Device. A protractor, digital inclinometer, or equivalent should be used to verify seat back frame angle.

3.3 Test Vehicle/Test Piece.

3.3.1. Body. One Body-in-White (BIW) is strongly recommended. If it is a body section that is deemed acceptable by the requesting engineer, it may be substituted. However, special consideration must be given to be certain the affected structural areas have the same stiffness as the full body. The test properties may be prototype or production depending on availability and level or design correctness desired.

3.3.2. Seat Frame. An untrimmed seat structure subsystem is required for this test. The appropriate engineering representatives as described in section 3.6 should verify the revision level and the suitability of the seat hardware for the test.

3.4 Test Time. The following is an estimate of the amount of time (work hours) needed to perform this procedure. These time estimates are approximate averages. Actual times vary considerably depending on early component problems (and subsequent availability of replacement parts), testing to varying multiples of cycle lives, varying requirements for frequency of environmental test conditions, scheduling of test facilities, test equipment malfunctions, scheduling of overtime and/or multiple shifts, actual readiness of test samples upon receipt, unique or additional requests for detailed test information, running multiple samples (times shown are for one system), etc.

These times consider preparation and other downtime, actual test, and analysis of data in capturing a total calendar time. Report writing, approval, processing, etc., are not part of these times.

Calendar time:	3 days
Test hours:	24 hours
Coordination hours:	0 hours

3.5 Test Required Information.

3.5.1 Durability Cycle Requirement. These specifications can be found in the body structure SSTs.

3.6 Personnel/Skills. The following individuals are necessary to complete this test procedure.

Note: Although the job titles may vary by region, the intent is shown with each job title.

3.6.1 GM Structures Design Release Engineer. The engineer responsible for the vehicle structure including Seat Anchorage.

3.6.2 GM Seat Design Release Engineer. The engineer responsible for the seat subsystem including frame, mechanisms and trim.

3.6.3 GM Validation Engineer. The engineer responsible for a subsystem validation.

3.6.4 Testing Organization's Test Engineer. The engineer responsible to coordinate, guide, summarize, and document a test.

3.6.5 Testing Organization's Test Technician. Helps construct, assemble, and run a test.

4 Procedure

4.1 Preparation.

4.1.1 Visual Inspection. The seat subsystem design release engineer shall visually inspect the seat assembly for correct part numbers, quality of frame welds, proper fit and assembly, and the presence of all required parts. The body structure design release engineer shall visually inspect the structure to be tested for correct weld pattern, structural adhesive location, and ensure it is of the level desired for testing.

4.1.2 Setup Instructions for Full or Partial Body Structure Durability.

4.1.2.1 Lift the body structure (by crane to the desired bedplate). The body structure should lay flat on the bedplate (typically resting on the rocker flanges or frame). If the design will not rest flat, use appropriate materials to shim and support it.

4.1.2.2 Secure the body to the bedplate through the front and rear bumper attachments. Turnbuckles and wood or metal blocks may be used to stabilize and secure the body. The body should be restrained sufficiently well so as to provide a safe test setup, and to ensure that body movement does not negatively impact the performance of the test. The requesting test engineer shall agree to any body securing deviations.

4.1.2.3 Prepare the Hydraulic Actuators. The test setup should be agreed to prior to test equipment assembly.

4.1.2.3.1 Hydraulic Actuators. The actuators for the seat back portion of this test should have a minimum stroke of 250 mm. The seat cushion portion of this test uses a 100 mm minimum stroke actuator that drives the rocker arm.

4.1.3 Actuator Assembly. Install hydraulic cylinder assembly (actuator) into position as agreed at the correct load vector. Attach firmly to the bedplate, and ensure safe operation by inspecting hydraulic feed lines for leaks or other potential hazards. Attach hydraulic feed lines, slowly pressurize the system, and advance the cylinder approximately 5 mm with 1 kN force several times to ensure clearance and functionality around proximal components.

4.1.3.1 Actuator Alignment. The seat back actuator shall be aligned, unless otherwise agreed to by the seat design release engineer, perpendicular to the seat back 270 mm above the “H” point. The seat cushion actuator shall be aligned vertically 50 mm (approximately) forward of the “H” point, unless otherwise agreed to by the appropriate seat system engineer. Refer to Figures 1 and 2.

4.1.4 Test Fixture. A fixture comprised of stanchions firmly fixed to the bedplate and crossbars mounted over the top of the front motor compartment, as shown in Figures A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, and A12, for the purpose of actuator attachment will be required for this test. This fixture shall be rigid enough so flexibility of the fixture does not influence the final test outcome. Test fixture design number TLA-00258 should be referenced.

4.1.5 Seat Preparation. The seat structure subsystem to be tested should have a piece of steel bar stock large enough to span over the top of the seat back frame placed 270 mm (approximately) above the “H” point of the seat. Test fixture design number TLA-00258 should be referenced. The purpose of the bar stock is to allow the seat back actuator to load the seat frame. The seat cushion should be prepared to receive a loading pan, the center of which should be placed 51 mm forward of the “H” point.

4.1.5.1 Seat Mounting. Mount the untrimmed seat subsystem into the BIW using production intent fasteners. Any deviations should be noted. Visually inspect for loose or broken components. Also the seat assembly should be manually moved in order to detect any loose or non-functional fasteners. Torque bolts to design value. Torque values should be recorded in a torque log as shown in Figure A15.

4.1.6 Adjustment Setting. See the Body Structures SSTS for the seat position(s)/adjustment setting(s) that must be tested.

4.1.6.1 Recliners Design Back Angle. The test may include each seat in a different position so desired so as to evaluate different seat to structure load inputs. This shall be previously agreed to by the appropriate engineering representatives as described in 3.6. Also, it shall be noted in the final test report.

4.1.7 Test Planning. Create a test plan that details the timeline of events that are to take place in executing this procedure. See Figure A13 for a typical test plan. Actual test times may vary.

4.1.8 Sample Inspection. The test and requesting engineer(s) should inspect the test items to ensure all material listed in 3.3 are of correct design level and assembled properly. Note and record areas of visible metal deformation, cracks, etc., at or near the area being studied. The requesting engineer should be notified if these conditions exist and determine if the body structure should be replaced before testing begins.

4.1.9 Sample Preparation. This test is normally run on the test specimen in an “as received” condition. If it is requested to be run in a specifically adjusted condition, follow the applicable procedure(s).

4.1.10 If a change to the body structure includes adding hardware and specific directions are not given, then the change should be done following appropriate product assembly specifications, orientation, fit, assembly specifications, etc., for the system being evaluated. The engineering representatives as described in section 3.6 shall agree on the revisions, and they shall be noted in the final test report.

4.1.11 Spray white stencil ink on areas around the body structure seat attachment. This will enable visual inspections of the pillar and surrounding area for cracks, etc.

4.1.12 Fasteners. Fasteners should be indexed with a paint pen, torque seal, or equivalent, in order to detect movement of the fasteners. Straight lines should be made from the center of the fastener head to the striker or component that the fastener connects to.

4.1.13 Facilities and/or Equipment Preparation. Record all site and instrument calibration information on Data Sheet B1.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified in this document's text or by the requesting engineer, the typical environmental conditions for developing this test are the temperature; humidity and pressure at the test facility (3.1.1). Unless otherwise noted, these conditions are typically $22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, relative humidity of $40\% \pm 20\%$, and atmospheric pressure equivalent to the local barometric pressure which is variable during any given day and from day to day.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Find the load application point using the test setup method in Figure A1.

4.3.2 Attach the load application device. Place the pivot point of the loading device onto the load application point obtained in 4.3.1. Loading direction shall be perpendicular to the design seat back torso line Figure 2. The load on the load application point shall result, unless otherwise specified, in 450 N·m around "H" point.

4.3.3 Set the seat bottom form so that it is centered in the seating position. This form is to be placed such that it does not come into contact with the seat back in any way. Adjust the vertical actuator so that it attaches to the seat bottom form and is vertical to the bedplate. Set the load control device to apply the load specified in the Body Structures SSTs.

4.3.4 Load Application. Apply the load to the seat back and the seat until it reaches the number of cycles specified in the SSTs. The seat durability targets may be higher on commercial vehicles; therefore, the structure should be tested to the higher targets. For combined seat back and cushion, testing should be cycled out of phase so as to induce both types of loading damage. Table 1 shows a typical moment step chart. Note that this chart represents 162 000 km (100 000) miles and will need to be repeated to meet reliability requirements.

Note: For seats providing positions of three or more occupants, the load applied to each of the outboard seating positions may be the total weight of all occupants (3 or 4) divided by 2.

Table 1: Typical Moment Step Chart ^{Note 1}
(See Body Structures SSTs for Loads and Cycles)

Step Number	Number of Cycles	Seat Back Load (N)	Seat Cushion Load (N)
1	XX	XX	XX
2	XX	XX	XX
3	XX	XX	XX
Total Cycles per Block	XX		
XX blocks are required to represent 162 000 km (100 000 mi)			
Total Cycles per 162 000 km (100 000 mi)	XX		

Note 1: Combined cycles must be conducted 180° out of phase.

4.3.5 Test Setup Agreement. Prior to commencement of testing, the responsible test engineer, and product engineer/engineers if applicable as described in section 3.6, shall agree and document the agreement on CG583 titled Development/Validation Test and Vehicle Review, or an equivalent regional document. A sample of CG583 is shown in Figure A14. This document provides formalized evidence of agreement between the key stakeholders before testing begins.

4.3.6 Test Development. The test development goal is to reproduce the interfacing component input loads such as suspension struts obtained from the real time data acquisition.

4.3.7 Test Operation Instructions.

4.3.7.1 Use an iterative technique to achieve the desired loading in steps without introducing undesired loads.

4.3.7.2 Conduct laboratory simulation with the appropriate number of test cycles as defined in the durability cycle requirement or by the requesting engineer.

4.3.7.3 Photograph test setup.

4.3.7.4 After pretest assembly, inspections and preparations are complete, commence testing.

Monitor test periodically and look for unusual wear, hydraulic leaks, abrasions, or equipment malfunctions.

4.3.7.5 At each inspection period (per the current lab standard), visually inspect the load interface and the surrounding area. Any cracks or unusual wear should be recorded on the lab data sheet. The actuator assembly and interface simulation should not be removed, unless absolutely necessary. Repositioning fixture in exactly the same location is difficult, and any difference in location can affect the accuracy of the command signal reproduction.

4.3.8 Post Test Instructions.

Note: Every post test operation/measurement/ inspection must typically have a pretest equivalent to have any meaning or significance. A crack detected at the end of test means nothing unless there is pretest documentation verifying no crack existed prior to start of test. Inspect the area for cracks, part separation, damaged welds, fastener movement, etc., and note in the final test report.

5 Data

5.1 Calculations.

5.2 Interpretation of Results. At the completion of the test, the body structure should be free of cracks, broken welds or loose structural components. GMW14048 should be referred to for guidelines. Any of these types of characteristics should be photographed, and noted in the test report.

5.3 Test Documentation. With reference to this Test Procedure, the results shall be represented in a GM approved test report consistent with the CG190 Evaluation Report Template.

It shall contain a complete identification of the structural subsystem or the structural components (part number, lot number, etc.) Detailed pictures of the seat setup and the adjustments necessary to obtain the test load shall be included. If any cracks, breakage or weld damaging in the structure is found, pictures shall be taken. Observations and comments shall be recorded on an Observation log similar to the sample shown in Figure A15. Also, torque values and instrument calibrations should also be recorded on logs similar to those shown in Figure A16.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary.

Actuator: Any device (i.e., servo hydraulic actuated cylinder) capable of producing/applying the required loads.

Body Structure: The primary structure of the vehicle which includes the body, any significant structural members that may affect the stiffness of the body structure when the structural component or component interface is being evaluated.

Servo Hydraulic Controller: A closed loop feedback device that is able to adjust/control the actuator in order to reproduce loading conditions based on load magnitude and duration obtained from real time data.

7.2 Acronyms, Abbreviations, and Symbols.

BIW	Body-in-White
SSTS	Subsystem Technical Specifications
SUV	Sport Utility Vehicle

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW15936

9 Release and Revisions

This standard was originated in May 2008. It was first approved by Body Structures in July 2008. It was first published in July 2008.

Issue	Publication Date	Description (Organization)
1	JUL 2008	Initial publication.
2	FEB 2012	Update procedure to define what information should be given in the Body Structures SSTS. (Body Structures GSSLT)