



Door Sliding Side System - Upper Frame Rigidity Structure Test

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. To determine the deflection and plastic deformation characteristics of a sliding side door upper frame (header) when subjected to inboard and outboard loads.

1.2 Foreword. A door is secured to a rigid fixture, in approximate design position, while an outboard load and then an inboard load are sequentially applied to the upper frame. Upper frame deflection and set deflection readings are recorded for each load in an effort to evaluate the structural integrity of the doors upper frame. These loads can also be thought to represent those applied in the vehicle assembly process and during customer usage, such as in the following examples:

1.2.1 The door upper frame is loaded at the vehicle assembly plant at times when the doors are manually adjusted to meet gap and flushness requirements.

1.2.2 A positive seal force or **overcrown** is designed into the door system to minimize potential water leaks and wind/road noise. The upper frame is constantly subjected to this seal force during the times that the door is closed.

1.2.3 When driving, the differential pressure between the vehicles interior and its exterior varies. As a result, forces are applied to the doors header via pressure on the door window.

1.3 Applicability. This procedure applies to all passenger cars, light duty trucks, and medium duty trucks having sliding side door systems. For conventional swing open doors (with upper frames), see GMW15088.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Release Documentation. This includes: Master Process Documents (MPD), Local Process Plans (LPP), etc., which show any product assembly, orientation, fit, assembly specifications, etc., for the system being evaluated.
- Subsystem Technical Specifications (SSTS)
- Vehicle Technical Specifications (VTS)

3 Resources

3.1 Facilities.

- **Major Facility:** A laboratory providing the equipment listed in Section 3.2 and able to provide the testing conditions listed in Section 4.2.
- **Minor Facility:** A Facility with a Surface plate/bed plate.

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3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment. The following list(s) include fixturing 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 Fixturing.

3.2.1.1 Rigid stanchion, with associated tie-down clamps, to provide mounting for the servo linear actuator (Figure A1).

3.2.1.2 Attachments to connect the load cell to the servo linear actuator and to the load application fixturing (**U-Channel**, Figure A2).

3.2.1.3 Rigid stanchions for mounting the door, in approximate design position, on the surface plate (Figure A3). This can be achieved by attaching clamps along the doors front and rear hem flanges (Figures A3 thru A5). Place the highest clamps approximately 75 mm (3 in) below the belt (or as specified by the requesting engineer).

Note: The clamps should be positioned so as not to add structural support to where the upper frame attaches to the belt-line.

3.2.1.4 Rigid stanchion to hold the linear displacement transducer (see Figures A5 and A6).

3.2.1.5 Fixturing to position the displacement transducer near the load application point (see Figure A6).

3.2.1.6 Miscellaneous stanchions, tie-down hardware, etc., to mount and secure test equipment to the surface plate.

3.2.1.7 A fixture to apply load to the upper frame. A **U-shaped** bracket (**U-Channel**) as shown in Figures A2 and A6. This bracket allows loads to be applied in directions **toward the body** and **away from the body** without having to make fixturing adjustments.

3.2.2 Instrumentation.

3.2.2.1 Signal conditioners, a servo linear actuator controller, data acquisition, a computer and software that is used to generate a load vs. displacement plot.

3.2.2.2 Load cell with a capacity to handle the load that will be applied during testing (see 3.5.3.2).

3.2.2.3 Servo linear actuator with attachments and adapters (see Figures A1 and A2).

3.2.2.4 Torque wrench(es) with a capacity of approximately 1.5 times the fastener(s) required torque specification(s) (see 3.5.3.5).

3.2.2.5 Ultrasonic thickness tester (for measuring metal panel thickness) or a caliper (if testing non-metallic parts).

3.2.2.6 Protractor/angle finder, angle measuring instrument.

3.2.2.7 Layout dye or spray paint and a scribe suitable for marking any upper frame seams that may move or separate during testing (see 4.1.2.2).

3.2.2.8 Displacement transducer (such as a string potentiometer or digital linear encoder) with a minimum stroke of 100 mm (4 in). 50 mm (2 in) of stroke will be adequate but may require repositioning the displacement transducer if loads are applied in both directions, i.e., toward the body and away from the body. See Figures A5 and A6.

3.3 Test Vehicle/Test Piece. Additional information on test required material and its assembly can be found in the Release Documentation (see 2.3).

3.3.1 A Door-In-White (DIW) that has been through the production Paint and Bake Process. To cure any adhesives, sealants, etc., painting the panel is optional. The door should include the following: Any additional structural members and all their respective fasteners, and any fixed glass. The swing out glass provides no additional structural strength to the door. Therefore, it is not required for this test. If more than one sample is being tested, they should all be from the same side of the vehicle in order to minimize fixture modifications. However, in some cases it may be desirable to test both right and left hand parts due to tooling and manufacturing process variations.

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It is recommended that the test parts/assembly be dimensionally certified before testing is started.

3.4 Test Time. The following is an estimate of the amount of time (work hours) needed to perform this procedure.

Calendar time:	2 days
Engineer hours:	4 hours
Technician hours:	12 hours

Note: These time estimates are approximate averages. Actual times vary considerably depending on early component failures (and subsequent availability of replacement parts), testing to varying multiples of cycle lives, varying requirements for frequency of environmental test conditions, scheduling problems for test facilities, test equipment malfunctions, scheduling of overtime and/or multiple shifts, scheduling of **witnesses** for tests, 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.

3.5 Test Required Information.

3.5.1 The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested (reference VTS/SSTS).

3.5.2 Testing worst case scenarios may uncover some potential problems. Discuss with the requesting engineer if testing should include some worst case scenarios. Depending on which test is being performed and which level of parts or systems is being tested, consider if any of the following may apply: tolerance stack-ups, build variations, misalignment, minimum/maximum fastener torque(s), lubrication, environmental extremes, location of customer representative load application, symmetry (Left Hand vs. Right Hand), color, mold or die source, etc.

3.5.3 The following specifications or information are required to run this test:

3.5.3.1 Location(s) for load application.

3.5.3.2 Load magnitudes and directions and any specific sequence of load /location.

3.5.3.3 Maximum allowable deflection.

3.5.3.4 Maximum allowable set deflection.

3.5.3.5 All applicable fastener torque values and a description of whether the value is a nominal, minimum, or maximum torque value.

3.5.3.6 Any critical part thicknesses and measurement locations.

3.5.3.7 Specific door structural content (including adding or deleting parts).

3.5.3.8 Specific doors to be tested and any expectations of test data correlation.

3.6 Personnel/Skills. Prior experience in setting up and running similar tests and experience in the use of the referenced test equipment are critical to achieving the estimated times shown in 3.4.

4 Procedure

4.1 Preparation.

4.1.1 Sample Inspection.

4.1.1.1 The test and requesting engineers should inspect the test items to ensure all material listed in Section 3.3 is of correct design level and assembled properly.

4.1.1.2 If instructed to do so, use ultrasonic thickness tester (or some other suitable measuring tool, such as a micrometer or calipers for non-metal doors) to measure any critical part thicknesses specified by the requesting engineer.

The locations chosen for thickness measurement should be chosen because they are significant contributors to the door structural performance. Be aware that drawn (stretched) sheet metal sections may be significantly thinner than flat sections of the same part.

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Verify thickness measurements with the requesting engineer before beginning the test set up; if parts were made from the wrong stock, or are out of specification, it may be worthwhile to postpone the test until they are corrected.

Note: For the most accurate thickness measurements, carefully remove paint, primer, etc. where the thickness measurements will be recorded. Be sure to use non-destructive or non-abrasive means (such as a liquid paint remover) so the thickness of the part being measured is not altered. Do not attempt to remove any plated coatings (e.g., galvanizing).

4.1.1.3 Note any areas of metal deformation or irregularities before performing the test. This may aid in analyzing test results.

4.1.1.4 If the doors have not been through the Electrophoretic Priming Operation (ELPO) system, then they must be **baked** before testing in order to fully **cure** the adhesives in the hem, door beam, etc.

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

4.1.2.1 Remove all operable windows and related hardware, unless otherwise directed by the requesting engineer. However, if the door has stationary windows or glass, check with the requesting engineer to determine whether or not it should be in place before testing. It may add stiffness to the upper frame of the door.

4.1.2.2 Apply layout dye or equivalent to the flange(s) of the upper frame and scribe a line parallel to the flange(s) (all the way around the upper frame). This is done to help detect any movement or separation of the flange(s) that may occur during the test.

4.1.2.3 Mark the location of any/all spot welds, so they can be inspected after testing is completed.

4.1.3 Facilities and/or Equipment Preparation. Record the instrumentation calibration information on Data Sheet A1 or an equivalent document.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified in this documents text or by the requesting engineer, the typical environmental conditions for this test are the temperature, humidity and pressure at the major test facility (3.1). Unless otherwise noted, these conditions are typically 22 °C ± 3 °C, relative humidity of 40% ± 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. Unless this test is being performed on a competitive vehicle, analysis data should be available for the test being performed. For correlation purposes, communication between test and analysis personnel must take place to ensure that the loading conditions, restraints, and measurement locations are consistent between the test and analysis procedures.

4.3.1 Setup Instructions.

4.3.1.1 Using the **L** brackets, mount the door to rigid stanchions, in approximate design position, by clamping along the front and rear hem areas of the door (Figures A3 thru A5).

Note: When clamping the door, the upper edge of the upper clamp must be 75 mm ± 12 mm (3 in ± 0.5 in) from the C-line (upper edge of **beltline**) of the outer panel; and the lower edge of the lower clamp must be 75 mm ± 12 mm (3 in ± 0.5 in) from the doors **T-line** (lower edge of the door (Figures A3 thru A5).

4.3.1.2 At this time, locate and mark the points on the upper frame where load will be applied. Specified load locations should be based on the criteria described in 3.5.1. Clearly record these locations in the test report for reference and any future test repeatability.

4.3.1.3 If the angle of loading is not specified, measure and record the angle on the outer surface of the doors upper frame. The angle of loading should be perpendicular to the upper frame, outer panel surface and, therefore, 90 degrees from the angle just measured. See Figure A6.

4.3.1.4 Confirm that the test equipment is powered on.

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