



Door Sliding Side System - Torsional Rigidity Structural 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 system when subjected to torsional loads.

1.2 Foreword. A sliding side door is secured to a rigid fixture, in approximate body/design **position**, and an outboard load is applied to either the rearward upper area or the rearward lower corner area of the door. **Deflection** and **set deflection** readings are recorded for each load.

1.3 Applicability. This procedure applies to all passenger cars, light duty trucks, and medium duty trucks having sliding side doors.

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.

- CG190
- GMNA Body Test Lab Instrumentation Group documentation for instrumentation equipment and software.
- 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) and 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 conditions listed in Section 4.2.
- Minor Facility: A Facility with a Structural Surface Plate.

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.

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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.

3.2.1.3 Roller bracket mounting plate assemblies for the sliding door upper track, center track, and lower track sections (Figures A2 thru A5).

3.2.1.4 Rigid stanchions for supporting the door prior to mounting, and additional stanchions for mounting the door, by its roller brackets, in body **position**. (The roller bracket mounting plate assemblies are attached to these fixtures.)

3.2.1.5 Clamps and metal blocks to keep all the roller brackets from moving in the roller bracket mounting plate assemblies (Figures A3 and A5).

3.2.1.6 Fixturing to **position** the displacement transducer near the load application point (Figure A1).

3.2.1.7 Rigid lock pillar fixtures with a production striker for the rear latch and for the front latch (Figure A4).

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

3.2.1.9 Semi-spherical, rubber, load applicator approximately 70 mm diameter to apply the specified load(s) to the door's inner panel (such as the Blackhawk Manufacturing Company's Flex-Head Number Z539) (Figure A6). This applicator works well because it compresses to conform to the surface of the inner panel without slipping (unlike a hard-tipped accessory).

Note: Because **deflection** will be measured based on outer panel movement directly opposite of the inner panel load location, localized denting of the inner panel or flexing of the rubber load applicator at the load point will not affect test results.

3.2.1.10 Small piece of clay (25 mm cube) and a flat, thin metal plate (25 mm square) to embed into the clay to provide a flat surface for the indicator (Figure A6).

3.2.1.11 Rigid fixture to hold the servo linear actuator.

3.2.2 Instrumentation.

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

3.2.2.2 Torque wrench(s) with a capacity of approximately 1.5 times the fastener(s) required torque specification(s) (3.5.1.5).

3.2.2.3 Ultrasonic thickness tester (for measuring metal panel thickness) or caliper (for measuring non-metal panel thickness).

3.2.2.4 Displacement transducer such as a digital linear encoder or string potentiometer with a minimum stroke of 25 mm (Figure A5).

3.2.2.5 Load cell with a capacity of approximately 1.5 times the maximum specified load to be applied to the door's inner panel.

3.2.2.6 Servo linear actuator (with attachments and adapters).

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 and includes the following: front and rear latches, a locator pin, 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 the same hand 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.

3.3.2 Roller brackets and their respective tracks and fasteners.

3.3.3 Door Latches and/or Strikers with Their Respective Fasteners. It is recommended that the test parts/assembly be dimensionally certified before testing is started.

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Note: It is recommended that new roller bracket assemblies be obtained for each door tested due to possible bending of the brackets during testing.

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

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.

Calendar time: 2 days
Engineer hours: 8 hours
Technician hours: 16 hours

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested. Reference appropriate Vehicle Technical Specification/Subsystem Technical Specification (VTS/SSTS) documents (2.3).

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.

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

3.5.1.1 Location(s) for load application.

3.5.1.2 Load magnitude(s) and direction(s).

3.5.1.3 Maximum allowable **deflection**.

3.5.1.4 Maximum allowable **set deflection**.

3.5.1.5 All applicable fastener torque values.

3.5.1.6 Any critical part thicknesses and measurement locations.

3.5.1.7 Addition or deletion of structural members (i.e., windows, etc.)

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 insure all material listed in Section 3.3 is of correct design level and assembled properly. Check the test material for bent track sections or bent roller brackets and for any damage to the rollers. Discuss with requesting engineer for any further action.

4.1.1.2 If instructed to do so, use the ultrasonic thickness tester (or another suitable measuring tool such as a caliper for non-metallic doors) to measure critical part thickness in the areas specified by the requesting engineer.

4.1.1.2.1 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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4.1.1.2.2 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 Any areas of metal deformation or irregularities before performing the test. This may aid in analyzing test results.

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 any windows and related hardware as specified by the requesting engineer.

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

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 this test are the temperature, humidity and pressure at the major test facility (3.1). 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.

Note: 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 Constrain the door in approximate body **position** by supporting or clamping it along the front and rear vertical hem flanges.

4.3.1.2 Clamp the locator pin to an L-bracket mounted on the stanchion. If the geometry of the pin makes it difficult to clamp, remove the locator pin and use an L-bracket (with appropriate cross section) attached to the door panel.

4.3.1.3 Mount sections of track that correspond with the roller brackets being constrained to stanchions so each section of track is in its appropriate body **position**. Each section of track used should be the portion of the track that the roller bracket rests in when the door is in the closed **position**.

4.3.1.4 Align and adjust the stanchions with the roller bracket mounting plate assemblies to the door's roller bracket assemblies. Slide the track section onto the end of each of the door's roller bracket assembly and adjust it to the closed **position** orientation. Scribe or otherwise mark the **position** of the roller bracket assemblies relative to the door and fixture. If applicable, also scribe along the door's hem line. This scribing is done to help detect any movement of the hem or roller bracket assemblies that may occur during testing (Figures A3, A4, and A5).

4.3.1.5 Tighten all stanchions, etc., making sure during tightening, nothing shifts causing a pre-load into the door structure.

4.3.1.6 Place a metal block (or clamp) in the track in front of and behind the lower roller bracket. Clamp the blocks in place to restrict fore-aft movement of the roller bracket during testing (Figures A3 and A5).

4.3.1.7 Place a metal block (or clamp) in the track in front of and behind the center roller bracket. Clamp the blocks in place to restrict fore-aft movement of the roller bracket during testing.

4.3.1.8 Place a metal block (or clamp) in the track in front of and behind the upper roller bracket. Clamp the blocks in place to restrict fore-aft movement of the roller bracket during testing.

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