



Door Inner Panel - Vibration Shaker Method to Simulate Slam Durability 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 evaluate the door's inner panel structure when vibrated using a specified Power Spectral Density (PSD) profile. This procedure simulates the action and reaction of conventional door slams, but does not involve any actual slamming or closing of the door.

1.2 Foreword.

1.2.1 There are currently two different, actively used procedures for door slam durability. One involves physically slamming the door in a customer representative way, using procedure GMW15094 (a pneumatically actuated method). This procedure describes a vibration method using an electro hydraulic/ magnetic shaker.

The pneumatic method is predominantly used to validate the door system for production. The shaker method is used to predict material fatigue in the door's inner panel structure during a shorter, accelerated time interval, but must still typically be tested under GMW15094 to fully prove or validate the door system's durability.

1.2.2 This test procedure may require pre-test data reduction. All files required for the pre-test data reduction need to be in raw text or American Standard Code for Information Interchange (ASCII) file format. Matlab or equivalent software is required to reduce the data.

1.3 Applicability. This procedure applies to all passenger cars, light duty trucks, and medium duty trucks having a vertically hinged door system. This test does not currently apply to sliding side doors. This test is performed off body on a single door, due to safety, facility, and material constraints.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15094

2.3 Additional References.

- CG190
- 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.
- Vehicle Technical Specifications/Subsystem Technical Specifications (VTS/SSTS). Reference pertinent Subsystem Technical Specifications for door slam requirements found in Section 3.1.5.1 (Cycle Definition - Door Slam Durability) of 55.01.01, Front Side Door SSTS and 55.01.02, Rear Side Door SSTS.

3 Resources

3.1 Facilities. The facility should have all of the equipment listed in Section 3.2 and be capable of providing the conditions required in Section 4.2.

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- Surface plate/bed plate.
- Overhead crane/hoist.

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. Section 3.2.1 and Section 3.2.2 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 Any fixture or stanchions capable of securing the closure panel rigidly. The quantity of stanchions may vary depending on how rigidly they secure the door and the unsupported span between them. The door can be mounted to the fixture or stanchions by any means that will secure the door rigidly. Due to the frequency of performing this test, it is recommended that clamping the door to universal fixtures or stanchions would reduce the cost of manufacturing new fixtures or stanchions, or modifying the existing ones for every new test.

3.2.1.2 In order for the door to be properly secured, the fixtures or stanchions must be able to clamp the door along the outer perimeter, usually along the hem flange. To prevent pre-loading the door, the header (or door upper frame) must be clamped if the door comes equipped with a window. If the door does not come equipped with a window, clamp the door along the beltline.

3.2.1.3 All fixtures or stanchions must be a rigid body with minimal beaming, breathing, and torsional effects in order to reduce force transmissibility loss. The fixture or stanchions must be able to operate at frequencies higher than 200 Hz to prevent any resonance. Using the above said criteria, a fixture design group (or equivalent) must verify that all fixtures or stanchions meet the 200 Hz criteria prior to use. See Figures A1 thru A5.

3.2.2 Instrumentation.

3.2.2.1 Electro hydraulic/magnetic shaker with a controller capable of producing the desired frequency range (required 0 Hz to 100 Hz, preferred 0 Hz to 200 Hz) and desired load capacity (required 0 N to 30 000 N, preferred 0 N to 55 000 N).

3.2.2.2 Signal analyzer (such as Data Physics model 7015).

3.2.2.3 Vibration controller software (such as Data Physics Signal Star Vibration Controller) capable of producing the desired power spectral density profile.

3.2.2.4 Dedicated computer capable of supporting the vibration controller software and the signal analyzer.

3.2.2.5 Single axis accelerometers capable of a range between 0G to 100G (such as Silicon Designs). Typically, three are needed.

3.2.2.6 An ultrasonic thickness tester, calipers, or micrometer (depending on panel material).

3.2.2.7 A 12 V power supply with appropriate wiring and connectors if the test door has a power window installed.

3.2.2.8 Software to convert acceleration data into a PSD profile (such as Matlab, RPCpro, or nSoft software).

3.3 Test Vehicle/Test Piece. The door system to be tested should include the outer panel, inner panel, window regulator if a movable window is present, the window(s) whether fixed, movable, or a combination of the two, latch, speaker, glass run channels and belt strips. All other door hardware should not be installed unless otherwise specified by the requesting engineer. A white painted door is preferred but not required for aiding in crack visibility.

It is recommended that the test door system as well as the accompanying assemblies/parts be dimensionally certified before testing is started.

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

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

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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: 13 days

Engineer hours: 15 hours

Technician hours: 8 hours

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested. (See VTS/SSTS as applicable. See 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 are required to run this test.

3.5.1.1 The requesting engineer is responsible for determining whether or not a generic PSD profile or a platform specific PSD profile will be used.

3.5.1.2 Torque specifications and whether to use the upper or lower limit or nominal value for each fastener.

3.5.1.3 Clamping locations along the header, beltline, and hem flange.

3.5.1.4 Pre-test and post-test of window regulator function.

3.5.1.5 Frequency of inspections.

3.5.1.6 Window positions and time duration at each position.

3.5.1.7 Environmental conditions.

3.5.1.8 Specific hardware/trim content on the test door.

3.5.1.9 Specific surface areas that may experience structural damage due to high stress concentration.

3.5.1.10 As applicable, inner panel gage measurement locations and limits.

Note: Due to the accelerated cycling rate, visible material fatigue may develop quickly. The requesting engineer may want to specify a shorter time interval (30 minutes) between inspections.

3.6 Personnel/Skills. Prior experience in setting up and running similar tests, experience in the use of the referenced test equipment, and experience using Matlab or equivalent software 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 3.3 is of correct design level and assembled properly. Check for any cracks and noticeable damage in the door structure and document accordingly.

4.1.1.2 As applicable, check all door components for proper function and determine that rivets are secure and all fasteners are torqued to specification (3.5.1.2). Mark all fasteners with a paint pen so movement can be detected.

4.1.1.3 Use an ultrasonic thickness tester (or other suitable measuring tool, such as a micrometer for non-metal panels) to measure critical part thickness specified by the requesting engineer. Typical measurements

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