



Door System - Inner Panel/Trim Breathing Structural Test

1 Introduction

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 door inner panel/trim maximum inboard and outboard displacement due to the window regulator forces as the window glass cycles or moves up and down. This procedure can be conducted both with and without the interior trim attached to the door.

1.2 Applicability. This procedure applies to all passenger cars, light duty trucks and medium duty trucks having any regulator driven window system (this may include side doors, rear cargo doors, quarter windows, station wagon endgates, etc.) Inner panel breathing of swing-out window systems and sunroofs may also follow the logic of this procedure, but may require unique considerations and/or modifications.

1.3 Remarks. This test is often run in conjunction with test procedure GMW15843 Closure Panel System - Inner Panel/Trim Flutter Structural Test.

Note: Discuss with the requesting engineer if this test is to evaluate the door inner panel, or the door interior trim panel, or both. If both, resolve the desired priority.

Note: If the test is to be run "by itself", the basic dial indicator instrumentation may suffice. If it is to be run in conjunction with GMW15843, the more sophisticated instrumentation and fixturing may be required. See 3.2.2 Instrumentation.

Note: Throughout this test procedure, the descriptions and methods of testing inner panel/trim breathing are predominantly based on the use of non-contact displacement transducers such as a "Pulsonic" ultrasonic displacement sensor. The GMNA Body Test Lab, however, has performed "breathing" testing using dial indicators and also using high-speed video.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15843

2.3 Additional References.

- CG968 Front and Rear Side Closures Subsystem Technical Specifications (SSTS)
- Vehicle Technical Specifications (VTS)

3 Resources

3.1 Facilities.

- Major Facility: GMNA Body Test Lab or similarly equipped test facility.
- Minor Facility: Bedplate (for off body testing only).

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 by the GMNA Body Test Lab 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 – Manual or Power Window System. If testing a frameless glass system, a body or buck is recommended. Pressure against the glass from body mounted seals (typical in frameless door designs) or door overbend (typical in framed door designs) may cause more movement in the door inner/outer panel than with the glass in its “free” state. Discuss with the requesting engineer to determine if a body is necessary.

3.2.1.1 Rigid Fixturing for mounting a displacement sensor (i.e., Unistrut brand structural metal framing). See Figure A1 for details.

3.2.1.2 If testing a door “off body”, a rigid hinge pillar fixture and lock pillar fixture with production striker and hinges are necessary for mounting the door in approximate body position on a bedplate. A door cart can also be used, providing the measuring instruments are rigidly attached to the cart, not to the door, (in order to eliminate any relative movement).

3.2.1.3 If testing a manual window system, an appropriate spindle adapter is necessary when using the handheld torque gun/transducer, or a handle adapter is necessary when using the manual window console.

3.2.2 Instrumentation – Power or Manual Window Systems.

3.2.2.1 For A Power Window System.

3.2.2.1.1 A regulated power supply (20 VDC, 50 A), or any sequence controller with a built-in power supply.

3.2.2.1.2 A handheld DC voltmeter.

3.2.2.1.3 A wire lead with proper connectors is necessary between the window regulator motor and power supply (the combined length and gage of the wire should have a resistance equivalent to the vehicle wiring system).

3.2.2.2 For A Manual Window System.

3.2.2.2.1 A manual window performance console or handheld torque gun (transducer equipment).

3.2.2.2.2 A torque display/calibration box, power supply, and proper wire connections.

Note: If the specified torque is beyond the torque gun’s capability, a torque wrench and proper adapters may be used instead.

3.2.2.3 For Power and Manual Window Systems.

3.2.2.3.1 Displacement measuring devices, such as string potentiometers, dial indicators, or the “Pulsonic” Ultrasonic Displacement Sensor and its sensor controller, the laser displacement sensor, and any associated instrumentation, etc.

Note: The laser sensor currently used in the GMNA Body Test Lab has a range of 40 mm.

3.2.2.3.2 Data acquisition equipment, if using the ultrasonic displacement sensor or the laser sensor.

3.3 Test Vehicle/Test Piece.

3.3.1 This test requires a fully assembled door, including door trim and related hardware (i.e., a manual or power window system and a complete glass guidance system, including belt strips, run channels, stops, etc.) It is recommended that the door assembly be dimensionally certified before testing is started.

3.3.2 If testing for trim breathing, a fully trimmed and assembled door is required. If testing for inner panel breathing, only a fully assembled door without trim pad is required.

Note: If the window belt seal is integral with the trim panel, the upper portion of a trim panel will have to be installed, with the lower portion removed (to provide access to measure the door inner panel motion). This may be more conveniently done with a second trim pad.

Note: All doors must be painted and heat cured per the production paint process. This is to assure all adhesives and sealants have been properly “cured” or heat set. Several iterations of trimmed and untrimmed doors can be performed to determine the relative contribution of each condition. Other considerations for the door assembly are components such as power or manual window regulators, speakers, switches, and lock modules. It is also recommended that the door assembly be dimensionally certified before testing is started.

Note: If not testing on a body, the resulting data may not be equal to data obtained from testing on a body (due to upper frame overbend stress or seal loads on the door or window system).

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

Calendar time:	4 d
Test hours:	18 h
Coordination hours:	24 h

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 (1) 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 this time.

Note: The times shown are for one (1) door, eight (8) measurement points.

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested. Reference Vehicle Technical Specifications (VTS) and CG968 Front and Rear Side Closures Subsystem Technical Specifications (SSTS) paragraph numbers, if 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.

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

3.5.1 Measurement location(s) coordinates on trim/inner panel.

3.5.2 Maximum allowable displacement of trim/inner panel.

3.5.3 Door hardware and trim level (refer to 3.3).

3.5.4 Manual Window System Stall Torque.

3.5.5 Power Window System Running voltage, Stall Voltage, and Supply voltage (may also require vehicle wiring resistance value).

3.5.6 Seal forces.

3.5.7 Desired weather strip compressive set duration.

3.5.8 Clarification of desired reference “zero” point (i.e., windows full up).

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 “Test Time” (see 3.4).

4 Procedure

4.1 Preparation.

4.1.1 Sample Inspection. The test and requesting engineer should inspect the test items to ensure all material listed in 3.3 is of correct design level and assembled properly. A check should also be made to verify that no cracks or broken heat stakes, or loose staples/fastening devices can be found on the trim pad assembly.

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 Determine, with the requesting engineer, the item to be tested first (inner panel or trim pad) and then, the area(s) on the door inner panel or trim pad at which the “breathing” is to be measured. Mark each desired location. At least one of the locations should be at an area at which the greatest displacement is expected to occur. A sketch or drawing illustrating the test location(s) should be made and included with the test data. (A UG picture of the inner panel and of the trim pad installed on the inner panel form the Design Engineer prior to starting the test is recommended.)

4.1.2.2 It is suggested that the weather strip undergo a compressive set with the door closed and fully latched before testing begins. The typical time period is 72 h (see 3.5.8). **Note:** 72 h is considered “aged” seals, but for purposes of this test, 48 h “set” period will suffice.

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4.1.3 Facilities and/or Equipment Preparation. Record the instrumentation calibration information on Data Sheet A1 Instrument Calibration. **Note:** Some test labs have their own unique data storage systems; these may be used in lieu of the Data Sheet A1 if desired, as long as all pertinent data displayed on Data Sheet A1 is documented in this alternate system.

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 test facility (3.1). Unless otherwise noted, these conditions are typically $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$, 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 Setup Instructions. Perform any functional tests, operational tests, or general evaluations as requested or as may be referenced in Section 2. Specifically, make sure all fixturing is rigid and in place, and that the sample data plot is recording oscillations within the window travel duration. As applicable, note any irregular sounds or erratic operation indicating a potential problem with design, manufacture, or assembly and verify observations with the requesting engineer.

4.3.1.1 If not testing on a body, mount the door assembly to the rigid hinge and lock pillar fixtures, or to a door cart, in approximate design position. If using clamps, clamp only to the outer panel flanges or hinges in such a way that the possibility of distortion is minimized.

Note: If the door's inner belt seal is integral with the trim, testing without the trim pad may not provide proper load reaction and resulting "breathing".

4.3.1.2 Cycle the window system through at least 5 full cycles to ensure proper operation and seating of all system components. Note any irregular sounds or interference indicating a potential problem with assembly or design, and verify observations with the requesting engineer. At the same time, visually note where the maximum inner/outer panel movement is occurring to assist in correlating with the measurement positions established in 3.5.1. If different locations are observed, discuss (with the requesting engineer) and finalize all measurement locations and re-mark the desired test measurement locations (4.1.2.1).

4.3.1.3 If testing a manual window system, adjust the stall torque of the test equipment to the specified value (see section 3.5.4). The method of adjustment varies with the type of equipment used.

4.3.1.4 If testing a power window system, make voltage adjustment to the power supply to obtain the required voltage value (3.5.5).

4.3.1.5 Position the displacement sensor at the desired test location. Rigidly affix the sensor's mounting fixturing to the interior of the body or door cart such that it measures displacement perpendicular to the plane of the door's inner panel (i.e., measures displacement in the direction of panel movement). Make sure the fixturing, as referenced in 3.2.1.1, is rigidly mounted.

Note: The inboard and outboard location of the sensor should be adjustable to compensate for limited displacement sensor range.

Note: The displacement sensor chosen should be able to read a measurement off any type of surface. If the sensor is sensitive to the uniformity or glossiness of the panel and is having difficulty in locating the test surface, add a small piece of tape to the marked point to make the surface uniform. Also, the sensor may have difficulty picking up slanted surfaces, so it is imperative that the surface measured is perpendicular to the displacement sensor's direction of signal output. A small amount of clay may be used to build up a slanted surface of the trim/panel so it is normal to the sensor.

Note: Repeated removal and installation of the trim pad may loosen or damage the trim pad fastening system, thereby affecting the validity of the "Post Test Instructions" (see 4.3.3).

4.3.1.6 Connect the displacement sensor to the plotting equipment.

4.3.1.7 With the door system closed and latched onto the body striker, adjust the sensor location/fixturing (within the limits of the sensor) to distances recommended by the sensor's equipment manual.