



Windshield and Backlight Dynamic Stress

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. This is a vehicle level test. The purpose of the dynamic testing is to determine the strain imparted to the windshield or backlight by the dynamic forces that occur while driving the vehicle under various conditions.

1.2 Applicability. This procedure applies primarily to the evaluation of all new program windshields or backlights. It may be used to evaluate various installation processes, glazing, and adhesive materials. This standard applies to all passenger vehicles, multi-purpose vehicles (MPV), and trucks.

1.3 Remarks. This document is the GM Worldwide Glazing Testing Standard. Its purpose is to establish a common test methodology for glazing systems to ensure that a high quality world class system is consistently developed and produced. This is a living document and any suggestions or revisions will be reviewed and/or updated annually by the Fixed Glass Global Subsystem Leadership Team (GSSLT). This test is often performed at the conclusion of the windshield and backlight static stress test, the strain gage method utilizing the strain-gaged windshield or backlight that was installed during that test. The dynamic forces that affect the windshield or backlight include body beaming, body torsion, aerodynamic forces, air bind, rough road suspension inputs, vibration, etc.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3059

GMW3600

GMW15443

GMW16599

2.3 Additional References.

- CG180 (ID) - 5-phase Document.
- GM Security Guidelines. <https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx>.
- Master Process Documents (MPD) and Service Manuals
- Program Specific Component Technical Specification (CTS).
- Subsystem Technical Specification (SSTS).
- Vehicle Technical Specifications (VTS).

(ID) = This document is limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

3 Resources

3.1 Facilities. The test facilities shall be accredited to the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) standards or by the International Laboratory Accreditation Cooperation (ILAC). Milford Proving Grounds or any similarly equipped test facility capable of performing the following sub schedules of GMW15443.

- Ride and Handling (RH) Loop

- Twist Ditch
- Belgian Blocks
- Sixteen (16) Degree Driveway or simulator with Road Load Data Acquisition (RLDA)

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

3.1.1.1 All instrumentation is to be calibrated as required. Record instrumentation details and date of calibration on Appendix A, Data Sheet A1. If the information otherwise preserved in the testing laboratory records or corporate archives, then recording on Data Sheet A1 is not required.

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.

3.2.1 Glass checking fixture for the vehicle windshield or backlight being tested.

3.2.2 Enough strain gages to satisfy the layout diagram for each windshield or backlight to be strain gaged (typically 12).

3.2.3 An appropriate number of signal amplifiers/conditioners.

3.2.4 Windshield or backlight removal and installation tools such as suction cup handlers, knives, or cutters, etc.

3.2.5 Adhesive caulking gun (manual or pneumatic).

3.2.6 Data recording and/or charting equipment such as computers, strip recorders, etc.

3.2.7 Five millimeter (5 mm) to 7 mm (¼ in) low density foam padding.

3.2.8 Digital camera.

3.2.9 Personal Protection Equipment (PPE).

3.3 Test Vehicle/Test Piece. Test samples shall be of production-intent design and material for design validation (DV) or production-intent design and materials manufactured with production processes (home line) for product validation (PV). Any changes to the components or material, e.g., design, fit, form, function, properties, manufacturing process, and/or location of manufacture, require revalidation. GM shall approve validation methods for product/process changes before the supplier is committed to the change. Refer to GMW3600.

3.3.1 A dimensionally certified Design Intent drivable and roadworthy test vehicle.

3.3.2 Minimum of two (2) windshields or backlights (the second windshield or backlight serves as a backup to minimize the delay of the test, should the first one break during installation).

3.3.3 Acoustical strips, windshield/backlight spacers, windshield/backlight moldings, cowl screens, adhesives, primer, and anything else needed to install a windshield or backlight.

3.3.4 A diagram depicting the desired layout of the gages on the windshield or backlight. This should be provided by the Design Engineer (DE). Typically, the gages are placed at points of stress, such as points where the cowl screen, windshield/backlight moldings, side moldings or other items are attached.

3.3.5 A diagram depicting the body position angle of the windshield or backlight.

3.3.6 Appropriate Master Process Documents (MPD) and Service Manuals.

3.3.7 All components/systems used in testing shall be within drawing specifications and have supporting data prior to start of test

3.3.8 All test samples are to be individually marked using a unique numbering system.

3.3.9 All test samples are to have a Bill of Materials (BOM). The BOM is to identify all release levels of the components in the test samples.

3.3.10 All Test Samples shall have dimensional data and all quality issues identified prior to conducting any testing or evaluation.

3.4 Test Time. The following is an estimate on the amount of time needed to perform this procedure. Included in total time is preparation and other downtime, actual testing, and analysis of the data.

Calendar time:	2 d
Test time:	8 h
Coordination time:	24 h

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3.5 Test Required Information. Requirements from the Subsystem Technical Specification (SSTS) or respective specification are necessary in order to execute test methods in this procedure. (See Section 4). For equipment and test sample details, see 3.2.

3.5.1 Notification. GM Validation is to be notified of test failures within 24 h period of occurrence.

3.5.2 Five (5) Phase. Supplier to develop five phase documents for all test failures. The Five Phase document shall be submitted within 48 h of test failure.

3.5.3 Product Security. Security protocol for the test vehicle must be followed per GM Security Guidelines.

3.6 Personnel/Skills. The test facility shall have sufficient personnel having the necessary education, training, technical knowledge, and experience for performing the required tests. Prior experience in windshield or backlight removal and installation setting up and running similar tests, strain gage installation, experience in the use of allied test, instrumentation, and recording equipment. In some cases, a driver may also be required. In either case, the person operating the vehicle during the road test must be licensed and must have completed the proving ground road tour and evasive driving class. Prior experience is critical in achieving the estimated times shown in 3.4.

4 Procedure

4.1 Preparation. If this test is being performed utilizing a vehicle with a stain gaged windshield or backlight that was installed previously, used to perform the "Windshield and Backlight – Static Stress Test, Strain Gage Method" (GMW16599), the instructions contained in 4.3.1 through 4.3.11, are not required.

4.1.1 Read the proper requirement from the SSTS.

4.1.2 Thoroughly read this GMW and any other associated GMWs.

4.1.3 Ensure that proper Personal Protection Equipment (PPE) is used during set up and testing.

4.1.4 Ensure the materials comply with GMW3059 and any regulatory requirements for country of sales.

4.1.5 Confirm Product Security Protocol for the vehicle tested by contacting the Vehicle Performance Manager (VPM). (Vehicles requiring camouflage, etc., must be carefully secured throughout the testing procedure so that no lapse in vehicle security occurs.)

4.1.6 Ensure that ALL components are at the proper release level and signed off by the Design Engineer (DE) and Vehicle Engineer (VE) prior to testing.

4.1.7 Ensure that all torques have been confirmed before test.

4.1.8 Ensure that all critical bolts have been marked before test.

4.1.9 Ensure that the fixture is in proper working order – proper representation of the body, no damage from previous test.

4.1.10 Ensure that all equipment is in proper working order, equipment is calibrated, counters are working properly.

4.1.11 Document environmental conditions (temperature, humidity, time and date) before start, during and end of test. All test samples are to be properly labeled using a permanent unique identifier. The numbering system shall be used in all phases of testing including DV, PV, Post Validation Audit (PVA), Development and any test incident retesting.

4.1.12 All test samples shall have a BOM that indicates release levels of the subsystem and components.

4.2 Conditions. All conditions specified shall be targeted toward the specified value with any given ($\pm$) tolerance used to compensate for variation. During testing, conditions specified shall not be readjusted within the tolerance unless it is to maintain the particular test condition within the specified tolerance. If such an adjustment is made, it shall be approved by the appropriate GM engineer prior to the start of any testing. Unless otherwise specified, perform the tests in the as-received condition without any special preconditioning.

4.2.1 Environmental Conditions. Ambient conditions: $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$. Document actual temperature on Appendix A, Data Sheet A1.

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 Carefully remove all windshield or backlight trim and hardware. These items may be required for the installation of the test sample.

4.3.2 Remove the existing windshield or backlight from the vehicle. Exercise due care and wear proper hand and eye protective equipment since the removal process often results in the breakage of the windshield/backlight. Remove all adhesive (urethane) from the flanges and prepare the vehicle for manual installation of the strain gaged windshield or backlight.

4.3.3 Place the windshield/backlight test sample on the glass, checking fixture and verify its contour and size.

4.3.4 Install strain gages on the test windshield/backlight, according to the layout diagram.

4.3.5 Place strips of 5 mm to 7 mm ($\frac{1}{4}$ inch) foam around the perimeter of the windshield/backlight opening area of the glass checking fixture. This will provide a soft flexible surface upon which the windshield/backlight can rest and minimize stress that might be induced by less than perfect nesting into the body opening area.

4.3.6 Align the glass checking fixture to match the angle of the vehicle body position.

4.3.7 Place the test windshield/backlight on the glass checking fixture, connect instrumentation and zero out the strain gages. Once zeroed, the glass should be removed from the checking fixture and reinstalled a minimum of three (3) times to ensure that the zero readings are stable.

4.3.8 Assemble the windshield/backlight per the MPD/Service Manual with all the appropriate hardware, and place in the body opening. Perform at least three (3) dry runs of this procedure, checking that the windshield/backlight is correctly nested into the proper plane and recording the strain gage reading each time to ensure that the readings are fairly stable with very little deviation.

4.3.9 If no problems are encountered, apply the primer and adhesive, and proceed with the final installation. During final installation, take strain gage readings at every step (placing windshield/backlight in the opening, wetting out the windshield/backlight, installation of cowl screen, etc.)

4.3.10 After the windshield/backlight is installed, the adhesive (urethane) must be allowed to cure for a 24 h period. Readings should be taken every 30 minutes for the first 4 h, and then every hour for the next four 4 h, or until the data readings stabilize. A final reading is taken at the expiration of the 24 h curing period. During this curing time, the amplifiers should not be turned off. Doing so will result in the loss of the zero mark.

4.3.11 Record any static readings taken in compliance with Appendix A, Data Sheet A2.

4.4 Data Collection on Test Track.

4.4.1 Prepare test log.

4.4.2 Become familiar with all sub-schedule routines.

4.4.3 Check tire pressure and ensure it is set to manufacturer's recommended pressure.

4.4.4 Inspect the windshield/backlight and verify there are no cracks or other structural damage.

4.4.5 Proceed to the test track and record the strain gage readings. While on the track running the following sub-schedules of GMW15443, identify start and end of each sub-schedule on the strip recorder or other recording device.

- a. Ride and Handling Loop
- b. Twist Ditch
- c. Belgian Blocks
- d. Sixteen (16) Degree Driveway

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Check windshield/backlight for cracks following the completion of each sub schedule and at the conclusion of the test. Check security of the windshield/backlight and condition of the adhesive (urethane). Review the data collected and compare with the specification provided by the release engineer. Any tensile stress readings over 6.89 MPa (1000 psi) are not acceptable. For laminate glass windshields, the pressure is determined by multiplying the micro strain readings by .073 (10.6).

5.3 Test Documentation. Record all test results on Appendix A, Data Sheets A1, A2, or A3, and include in the test report. Include photographs of the test setup and the individual test results.

Record any static readings taken in compliance with Appendix A, Data Sheet A2. This data sheet is not required if the vehicle used in this test was previously used to perform the Windshield and Backlight Static Stress Test, Strain Gage Method per GMW16599. Record pertinent dynamic test results on Appendix A, Data Sheet A3.