GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17039

Electric Window Defogger/Defrost Test Procedures

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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 procedure is used to validate the electric glazing defogger on fixed glass.

Note: If no specific requirement is in the program specific SSTS. The defaults in this procedure shall be used.

1.2 Applicability. This document is applicable for all car, Multipurpose Passenger Vehicle (MPV), and truck models of 4536 kg gross vehicle mass (weight) rating or less that have an electrically heated fixed window (rear or quarter) produced by GM Worldwide.

1.3 Remarks. This document is the GM worldwide electric window defogger testing standard. Its purpose is to establish a common test methodology for heated grids to ensure that a high quality world class system is consistently developed and produced. This standard is for the development phase of new technologies or suppliers but can be used for validation of the product. This document and any suggestions or revisions will be reviewed and/or updated annually by the Fixed Glass Global Subsystem Leadership Team (GSSLT).

2 References

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

2.1 External Standards/Specifications.

USCAR40

2.2 GM Standards/Specifications.

GMW3059	GMW3191	GMW15760
GMW3172	GMW3600	

2.3 Additional References.

- 9985864 - Part Number for GM Approved Windshield Cleaner.
- Best Practice Number: 105219 (see Knowledge Set Number 1268). The supplier shall work with the GM responsible engineer to comprehend this requirement (ID).
- CG180 – 5 Phase Document (ID).
- CG3707 - Heated Backlight Grid Calculation (ID).
- GM Research and Development Report AS-598 Hearing Acuity Standard for Squeak and Rattle Evaluators.
- GM Security Guidelines. https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx.
- Program specific Component Technical Specification (CTS).
- Subsystem Technical Specifications (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 ISO/IEC standards or by the International Laboratory Accreditation Cooperation (ILAC). However, all measuring variables as specified in this specification shall be determined correctly with respect to their physical definition.

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.

3.2.1 Fixture or buck to hold the backlight.

3.2.2 A 9 V to 16 V power supply capable of 20 A.

3.2.3 Voltmeter/Multimeter.

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3.2.4 Digital camera.

3.2.5 Personal Protection Equipment (PPE).

3.2.6 GM approved windshield cleaner, part number 9985864 or equivalent to assure water sheeting action.

3.2.7 Thermal Chamber large enough to minimally contain one (1) test buck. The chamber should also meet the following:

- Temperature Range (-40 °C to +95 °C) and continuously adjustable.
- Controlled humidity.
- Recirculating air temperature cabinet.
- Test room, suitable for the execution of the test.
- Permissible temperature accuracy: ± 3 °C.
- Explosion proof.

3.2.8 Modified Taber fixture ET-3421 (or equivalent) meeting the following specifications.

3.2.8.1 An articulated drive spindle having the following capabilities.

3.2.8.1.1 Two type CS-10F Calibrase wheels offset by 2.2 cm ($^{27}/_{32}$ in) from the vertical centerline of the spindle.

3.2.8.1.2 The wheels shall exert a total downward force of 1000 g upon the glass.

3.2.8.1.3 The spindle shall be perpendicular to the glass surface, this being accomplished by use of the adjustable three-point base the glass rests upon during the test.

3.2.8.1.4 The spindle shall rotate 65 rpm to 90 rpm.

3.2.8.1.5 A counter incorporated to record the number of spindle revolutions.

3.2.8.1.6 A counterbalanced arm to allow testing of any point on the glass.

3.2.8.1.7 A sensing circuit capable of stopping the motor and counter upon loss of continuity of the grid lines being tested.

3.2.8.1.8 A set of jumpers capable of connecting three consecutive grids in a series circuit and the ends of this series circuit to the failure sensing circuit.

3.2.8.1.9 Taber S-11 refacing discs mounted on a flat glass plate.

3.2.8.1.10 Type “A” durometer from Shore Instrument and Manufacturing Company (or equivalent).

Note: Calibrate all instruments as required and note instrument name, identification, and calibration date on the data sheet (see Appendix B – Data Sheet B1).

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. See GMW3600. Test Samples are to be determined using GMW15760.

3.3.1 Unless otherwise specified, three samples of components or systems shall be tested.

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

3.4 Test Time. Test time varies, see the individual test procedures for test time.

3.5 Test Required Information.

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

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

3.5.3 Five (5) Phase (CG180). Supplier to develop five phase document for all test failures.

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.

3.6.1 Hearing Requirements. It is recommended that all evaluators for customer actuated sound have a hearing test. Any professional hearing test is acceptable, but the following test is given is a reference: GM Research and Development Report AS-598, “Hearing Acuity Standard for Squeak and Rattle Evaluators”.

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3.6.2 Auditor Skill Level. Evaluators shall have completed 2 to 3 prior Customer Actuated Sounds (CAS) Vehicle Evaluations under the supervision of an experienced CAS Evaluator.

3.6.3 Prior experience in setting up and running similar tests. Experience in the use of the referenced test equipment.

4 Procedure

4.1 Preparation.

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 that the materials are in compliance to 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 Clean the glass prior to each test module with GM approved glass cleaner.

4.2 Conditions. All conditions specified shall be targeted toward the specified value with any given (±) 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 pre-conditioning.

Note: when changing from one temperature to another, do not thermal shock the glass.

4.2.1 Environmental Conditions. Test to be run at ambient. The following conditions apply to all tests unless otherwise specified:

- Ambient Temperature: +23 °C ± 3 °C.
- Voltage: V_{NOM} ± 0.3 V at terminals.
- Humidity is to be between 50% and 75% for all tests unless otherwise specified.
- T_{MIN} is -40 °C unless otherwise specified.
- T_{MAX} is +85 °C unless otherwise specified.
- 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.

Deviations must be approved by the GM Subsystem Validation Engineer (SVE) and Design Engineer (DE).

4.3 Instructions.

4.3.1 Electric Window Defogger – Abrasion Resistance Test Procedure.

4.3.1.1 Purpose. This test is used to determine the abrasion resistance of conductive elements on glazing materials.

4.3.1.2 Test Equipment.

4.3.1.2.1 Environmental chamber with the capability of temperatures down to -20 °C. Environmental chamber large enough to hold and fixture the production glass with an area for viewing and taking pictures. Thermal chamber large enough to contain fully assembled body glazing and capable of:

- Controlled humidity.
- Explosion proof thermal cabinet for circulating air operation with extraction.
- Continuously adjustable temperature range: -40 °C to +120 °C.
- Test room: Suitable size.
- Executions: Suitable size.

4.3.1.2.2 Abrasion wheel with measurable rotations and downward forces.

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4.3.1.2.3 Refacing disks.

4.3.1.2.4 Holding fixture for holding the glass horizontally under the spindle.

4.3.1.2.5 Stopwatch.

4.3.1.2.6 Oil based marker.

4.3.1.2.7 A 9 V to 16 V power supply capable of 40 A, and if necessary, an electrical power supply device that reflects vehicle electrical interface (mating connector, wire gage, control box, etc.)

4.3.1.2.8 Voltage and current measuring equipment for recording.

4.3.1.2.9 Digital camera capable of taking high quality pictures.

4.3.1.2.10 Temperature gauge.

4.3.1.3 Test Samples. Unless otherwise specified 6 samples are to be used.

4.3.1.4 Test Time.

Calendar time:	1 d
Test time:	4 h
Coordination time:	4 h

4.3.1.5 Test Preparation. See 4.1.

4.3.1.5.1 Clean the glass surfaces before testing to ensure no foreign material.

4.3.1.6 Test Conditions. See 4.2.

4.3.1.7 Test Procedure.

4.3.1.7.1 Place the test glass on the three leveling pegs on the base plate such that the middle line of the three to be tested is positioned directly under the vertical centerline of the spindle when the spindle is in test position.

4.3.1.7.2 Place the flat plate with the refacing disk on the backlight.

4.3.1.7.2.1 Lower the wheels until they touch the refacing disk and exert a downward force of 1000 g.

4.3.1.7.2.2 Allow the wheels to rotate on the resurfacing disk for 30 cycles.

4.3.1.7.3 Record observations in the data sheet for final test report.

4.3.1.7.4 Series connect the three lines to be tested and electrically isolate them from the remaining lines.

4.3.1.7.5 Attach the sensing circuit to the ends of the three line series circuit.

4.3.1.7.6 Lower the arm and energize the machine to allow the wheels to rotate. The sensing circuit will stop rotation when continuity ceases in the three line series circuit.

4.3.1.7.7 Record the number of cycles at failure.

4.3.1.7.8 Repeat 4.3.1.7.1 through 4.3.1.7.7. At the following six (6) positions on the glass: Upper right, upper left, lower right, lower left (motor spindle approximately 15 cm (6 in) from the busbar), and two (2) positions in the middle of the glass.

Note: The hardness of the wheels should be checked at approximately one (1) week intervals and should be between 65 and 80 Shore “A”.

4.3.1.8 Test Requirements or Acceptance Criteria. Test fails if there is a loss of electrical continuity during any test module.

4.3.2 Rear and Quarter Window 100 h Defroster Grid Test.

4.3.2.1 Purpose. To ensure the defroster grids can withstand 100 h of continuous use.

4.3.2.2 Test Equipment.

4.3.2.2.1 Thermal image camera.

4.3.2.2.2 Power supply.

4.3.2.2.3 Direct Current (DC) Power Supply.

4.3.2.2.4 Data Acquisition/Switch Unit.

4.3.2.2.5 Test Stand/Fixture.

4.3.2.3 Test Samples. Unless otherwise specified 6 samples are to be used. Samples are required to be chosen using GMW15760.

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4.3.2.4 Test Time.

Calendar time:	6 d
Test time:	100 h
Coordination time:	10 h

4.3.2.5 Test Preparation. See 4.1.

4.3.2.6 Test Conditions. See 4.2.

4.3.2.7 Test Procedure.

4.3.2.7.1 Using the thermal imaging camera take an infrared (IR) image of the glass test piece prior to running the test. Attach Thermal graphic photos to the test report.

4.3.2.7.2 The test samples are to be cycled "ON" with a voltage of 13.5 V Direct Current (DC) for a total of 100 h continuous.

4.3.2.7.3 During the testing, monitor and record resistance every hour. Record the temperature and humidity at start of test, 15 h, 30 h, 45 h, 60 h, 75 h, and 90 h and at end of test.

4.3.2.7.4 At Start of test, at the 24 h mark and after 100 h of testing, thermo-graphic photographs are to be taken of each test sample. Each sample shall be evaluated for temperature, current draw and appearance.

4.3.2.7.5 Record observations and test data, found during testing in the test report in Appendix C – Data Sheet C1.

4.3.2.8 Test Requirements or Acceptance Criteria. Observe the test samples for any changes in the part resistance. All elements of the test sample shall remain functional during and upon completion of the test.

The power requirement of heated backlights shall be the greater of:

a. A minimum of 500 W/m^2, or

b. The required watt density determined via the Heated Back Window Spreadsheet in Best Practice Number: 105219 (reference: Knowledge Set Number: 1268).

The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement. The maximum temperature of the busbars shall not exceed 60 °C when operated at 23 °C ± 3 °C at the voltage defined in the "dynamic" condition in CG3707.

4.3.3 Rear Window and Quarter Window Defrost Static Test Procedure.

4.3.3.1 Purpose. To validate the performance capability of electrically heated rear or quarter windows under a static condition. The data will be used to predict performance of the vehicle level dynamic test.

4.3.3.2 Test Equipment.

4.3.3.2.1 Environmental chamber with the capability of temperatures down to -20 °C. Environmental chamber large enough to hold and fixture the production glass with an area for viewing and taking pictures. Thermal chamber large enough to contain fully assembled body glazing and capable of:

- Controlled humidity.
- Explosion proof thermal cabinet for circulating air operation with extraction.
- Continuously adjustable temperature range: -40 °C to +120 °C.
- Test room: Suitable size.
- Executions: Suitable size.

4.3.3.2.2 Fixture for holding the glass at vehicles installed angle and 45 degrees.

4.3.3.2.3 Stopwatch.

4.3.3.2.4 Oil based marker.

4.3.3.2.5 A 9 V to 16 V power supply capable of 40 A, and if necessary, an electrical power supply device that reflects vehicle electrical interface (mating connector, wire gage, control box, etc.)

4.3.3.2.6 Voltage and current measuring equipment for recording.

4.3.3.2.7 Spray bottle.

4.3.3.2.8 Digital camera capable of taking high quality pictures.

4.3.3.2.9 GM approved windshield cleaner, part number 9985864 or equivalent to assure water sheeting action.

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4.3.3.2.10 Temperature gauge.

4.3.3.2.11 Holding fixture capable of adjusting the position to appropriate installation angle.

4.3.3.3 Test Samples. Unless otherwise specified 6 samples are to be used. Samples are required to be chosen using GMW15760.

4.3.3.4 Test Time.

Calendar time:	1 d
Test time:	4 h
Coordination time:	4 h

4.3.3.5 Test Preparation. See 4.1.

4.3.3.6 Test Conditions. See 4.2.

4.3.3.7 Test Procedure.

4.3.3.7.1 Clean the inner and outer surface of the glass with the GM approved cleaner or equivalent.

4.3.3.7.2 Mark on the outer surface of glass 2 marks (center of glass) approximately 50 mm long spaced between each grid line, using the spacing distance as in the equation (28.5/4 = 7.1). Mark 7.0 mm (rounded) going up and down from each grid line using oil based pen or permanent equivalent. Repeat in 2 areas (right and left of center) across the glass. See Figure 1.

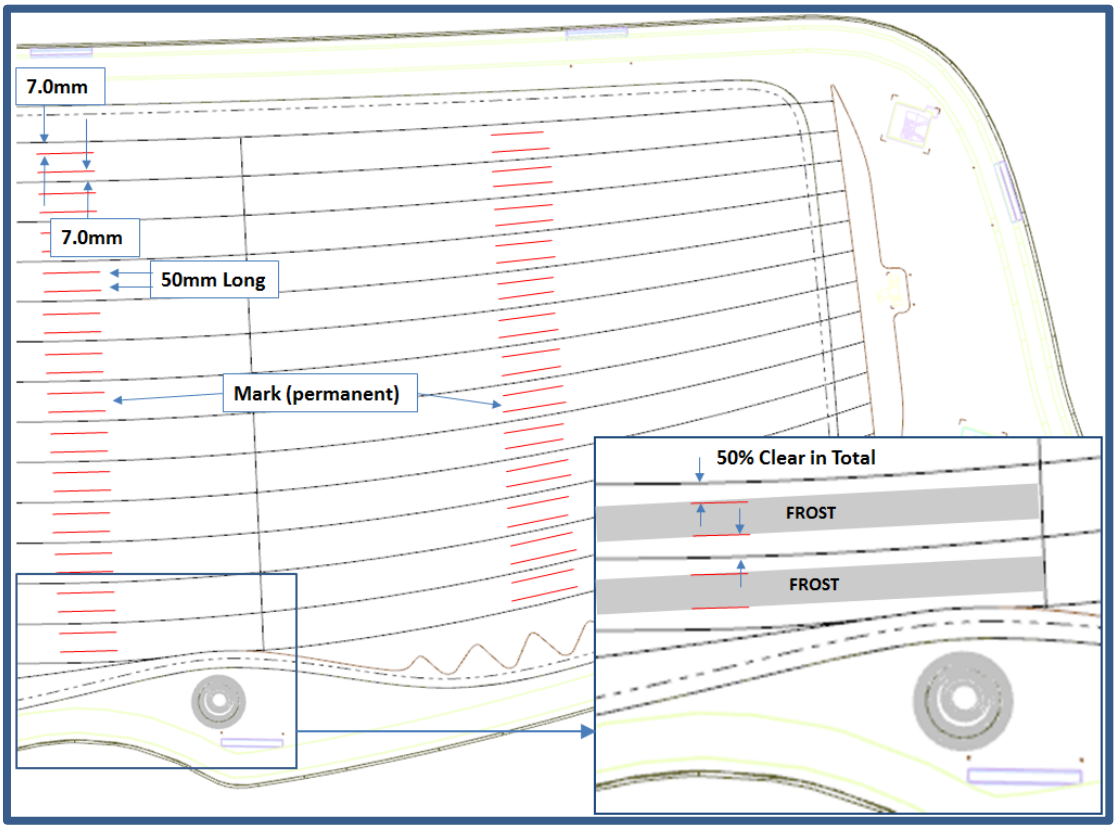

Figure 1: Proper Glass Marking

4.3.3.7.3 Measure the resistance of the heated grids at ambient temperature at vehicle amperage.

4.3.3.7.4 Fixture the part at a 45° angle. Take pictures perpendicular to part to ensure a high quality photograph.

4.3.3.7.5 Hold the part in environmental chamber at (-20 °C ± 2 °C) for at least 1 h prior to spraying.

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4.3.3.7.6 Spray the exterior/outside/class A surface of the part (approximately 500 mL/m^2) using a spray bottle, to build up a uniform ice layer on the exterior/outside/class A surface of glass. See Appendix D for proper frost procedure.

4.3.3.7.7 Continue to condition the test part in the environment chamber for a minimum of 30 minutes.

4.3.3.7.8 Connect the power source to the test piece.

4.3.3.7.9 Apply V_{NOM} to the test part and start timer.

4.3.3.7.10 Take photographs at 1 minute intervals until part achieves 100% cleared heated in Day Light Opening (DLO).

4.3.3.7.11 Record amperage and voltage at the glass heat elements for each 1 minute time interval.

4.3.3.7.12 Repeat procedure with the following exceptions:

- Use vehicle's idle voltage (V_{IDLE}) condition instead of V_{NOM}.
- Fixture the component at vehicle's installation angle instead of 45 degrees.

4.3.3.8 Test Requirements or Acceptance Criteria.

- The heated area of the DLO shall be 75% cleared within 10 minutes of operation at the idle vehicle voltage condition. Pictures will be used for judging percentage of clearing with approval from GM engineer. See Appendix A, Figure A1 and Figure A2.
- No hot spots in bus bar (minimize wasted energy).
- There shall be no areas of zoning within the heated area. Must defrost uniformly.
- Pictures to be reviewed with GM engineer and approved for clearance zone or any other irregularities within heating pattern.

4.3.4 Backlight Vibration Test Procedure.

4.3.4.1 Purpose. To validate the heated backlight connections meet the requirements of the program specific requirements for vibration and connector resistance to ensure the connector does not build up heat beyond acceptable limits. Note if no specific requirement is in the program specific SSTS. The defaults in this procedure shall be used.

Note: For backlights using a pigtail soldered to glass, Do not use this test but use GMW3172 for vibration and USCAR40 for solder joint.

4.3.4.2 Test Equipment.

4.3.4.2.1 Yazaki connector with lead wires - GM Part No. 13585268 – minimum based on test setup.

4.3.4.2.2 Thermal Chamber large enough to minimally contain one (1) test buck. The chamber should also meet the following:

- Temperature Range (-40 °C to +95 °C) and continuously adjustable.
- Controlled humidity.
- Recirculating air temperature cabinet.
- Test room, suitable for the execution of the test.
- Permissible temperature accuracy: ± 3 °C.
- Explosion proof.

4.3.4.2.3 Thermal coupler.

4.3.4.2.4 Multiaxial vibration table capable of supporting the backlight mounted in a fixture.

4.3.4.2.5 Fixture or buck to hold the backlight.

4.3.4.2.6 A (9) V to 16 V power supply capable of 20 A.

4.3.4.2.7 Voltmeter/Multimeter.

4.3.4.2.8 Digital camera.

4.3.4.2.9 Personal Protection Equipment (PPE).

4.3.4.3 Test Samples.

4.3.4.3.1 GM shall approve validation methods for product/process changes before the supplier is committed to the change. Refer to GMW3600.

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