



Air Inlet Panel Water Management Evaluation

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. The purpose of this procedure is to define and standardize the test methodology for evaluating water management capability of an Air Inlet Panel (AIP) system.

1.2 Applicability. This document is applicable for all car, Multipurpose Passenger Vehicle (MPV), and truck models produced by General Motors.

1.3 Remarks. This procedure shall be used to ensure that an AIP system deflects and manages water away from components per AIP Subsystem Technical Specification (SSTS) requirements. The AIP is aesthetically designed for closeout appearance but functionally deflects water away from plenum, shields the Heating, Ventilation and Air Conditioning (HVAC) Body Air Inlet (BAI), protects the windshield wiper motor from direct contact, and helps manage water from getting to underhood components.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3600

2.3 Additional References.

- 5 Phase Document
- 2011 D1SB-N AIP Water Management Wiper Motor Results 23July10
- Component Technical Specification (CTS)
- GM Product Security Guidelines (<https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx>)
- Subsystem Technical Specification (SSTS)

3 Resources

3.1 Facilities. Test facilities and the following equipment shall be in good safe working order.

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.

3.1.3 GM Universal Water Test Booth (See Appendix B, Figure B1).

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3.1.3.1 Roof Mounted Water Spray Bar. Roof mounted water spray bar with six (6) nozzles (or number needed to get specified flow rate). The nozzles are to be equally spaced.

Nozzle Example:

- Company - Spraying Systems Company.
- Nozzle Size: 10 mm (3/8 in).
- Nozzle Type: GG
- Nozzle Style: Full Jet Nozzle (model number QHSS15, or equivalent) to produce a cone-shaped spray.

3.1.3.2 Roof Mounted Fine Adjustment Water Spray Bar. Roof mounted water spray bar with perforated holes to allow water to flow onto the glass. Also includes a fine adjustment flow gage for flow rates < 7 L/minute (< 2 gal/minute).

3.2 Equipment.

3.2.1 Garden hose and water supply capable of delivering 30 L/minute (8 gal/minute) of water. (Appendix B, Figure B3).

3.2.2 High pressure spray wand system equipped with a fan spray nozzle. Operating pressure set to 758 kPa at 13 L/minute (1100 psi at 3.4 gal/minute).

3.2.3 Digital video camera with external cord and recording monitor (See Appendix B, Figure B2).

3.2.4 Measuring scale and white paint marker.

3.2.5 General tools to remove AIP, wiper arms, and disassemble wiper motor.

3.2.6 Water feeling paste to detect water leak paths by changing color under contact with humidity.

3.2.7 Stop watch to time different legs of the test

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 manufacturer, require revalidation. GM shall approve validation methods for product/process changes before the supplier is committed to the change. Refer to GMW3600. All components/systems used in testing shall be within drawing specifications and have supporting data prior to start of test.

3.3.1 New replacement wiper motor.

3.3.2 Interface Components. Stereolithography (SLA) components or otherwise mocked up component(s) of concern within the wiper module water management path that can be fitted into the vehicle (that are not available on the test vehicle).

3.3.3 Product Security. Security protocol (camouflage, covers, etc.), for the test vehicle must be followed per GM Security Guidelines.

3.4 Test Time.

Calendar time: 1 day

Test hours: 8 hours

Coordination hours: 4 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Wiper Systems and AIP Validation Engineers typically perform this test. It is suggested for Design Engineers to be present during the test.

4 Procedure

4.1 Preparation. Remove any non-adhesive camouflage from the vehicle that may impact the test.

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4.2 Conditions. All conditions specified shall be targeted toward the specified value with any given tolerance ($\pm$) 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 applicable 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. Temperature for all testing should be recorded on the test report.

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.

4.2.2.1 Part Orientation. Parts shall be tested in vehicle orientation unless otherwise specified.

4.3 Instructions.

4.3.1 HVAC Body Air Inlet (BAI) Evaluation. The purpose is to verify the AIP shields water from the plenum, and the water allowed into the plenum does not exceed plenum drain capability and result in water leaking into vehicle cabin through the body air inlet opening.

4.3.1.1 Remove wiper arms and air inlet panel system from vehicle and tape over BAI opening in case water level during the test exceeds top of BAI.

4.3.1.2 Using measuring scale and paint marker, make three (3) horizontal reference marks on HVAC body air inlet opening. Example of this can be found in Appendix C, Figure C1. Document the height of these marks from plenum floor in Appendix A, Data Sheet A1.

4.3.1.3 Install monitor inside the vehicle cabin and position the digital video camera in plenum near the vehicle centerline so the camera is aimed at HVAC body air inlet, and paint marks can be seen. For vehicle architectures that do not have a plenum, the camera will be placed in the engine compartment. Example of camera positioning can be found in Appendix C, Figure C2.

Note: Make sure final camera position and wiring will not be damaged when wiper system is operating.

4.3.1.4 Re-install AIP and wiper components back on vehicle and place vehicle in Universal Water Test Booth (UWTB).

4.3.1.5 With the HVAC blower off, start eight (8) minute UWTB water test and video record the first and last 30 s of the test. If at any time during the test the water is seen overflowing into the HVAC air inlet, stop the test immediately.

4.3.1.6 Save the videos and load into Global Document Management (GDM) System so they can be referenced in evaluation report and note any findings on Appendix A, Data Sheet A1.

4.3.1.7 Test Requirements. Refer to the program specific SSTs for test requirements. If there are no test requirements, use the following:

- Plenum water shall **not** enter the BAI.
- Water level in the plenum shall not touch the wiper linkage nor the motor.
- Water not allowed to submerge the wiper motor.

4.3.2 Wiper Motor Evaluation. The purpose is to verify AIP prevents water from draining directly onto the wiper motor and to verify the maximum water level observed in the plenum does not submerge any part of the wiper motor or module during UWTB. Test also verifies there are no points of entry for water into the wiper motor during UWTB exposure.

4.3.2.1 Remove wiper arms and air inlet panel system.

4.3.2.2 Position digital video camera and light in plenum near vehicle centerline so camera is aimed at wiper motor. For vehicle architectures that do not have a plenum, the camera will be placed in the engine compartment. Example of camera positioning can be found in Appendix C, Figure C3.

Note: Make sure final camera position, lighting, and wiring will not be damaged when wiper system is operating.

4.3.2.3 Re-install AIP and wiper components back on vehicle and place vehicle in UWTB.

4.3.2.4 Turn on water for high pressure wand and aim nozzle at AIP openings near wiper motor, keeping end of nozzle approximately 30 cm (12 in) away. Go over wiper motor area ten (10) times holding wand at different angles each time to best simulate normal customer usage.

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4.3.2.5 With the HVAC blower off, start UWTB water test and video record the first and last 30 s of test.

4.3.2.6 Save videos and load into GDM so they can be referenced in evaluation report and note any findings on Data Sheet A1 of Appendix A.

4.3.2.7 With vehicle in UWTB and no water being sprayed, operate wipers at high speed (dry glass) for 10 minutes so wiper motor reaches operating temperature.

4.3.2.8 Within one (1) minute after wiper motor is turned off, start eight (8) minute UWTB water test while wiper motor is still warm. No video recording is needed during this time.

4.3.2.9 Remove vehicle from UWTB and let vehicle drip-dry for five (5) minutes to ten (10) minutes in garage area.

4.3.2.10 Remove air inlet panel subsystem, video camera, and wiper module from vehicle.

4.3.2.11 Using a low pressure air hose, blow off any excess water from wiper module, especially near wiper motor.

4.3.2.12 Disassemble wiper motor and inspect for any water or water trace inside motor or wire harness connection. Document the inspection for evaluation report by taking pictures of disassembled motor.

4.3.2.13 Replace motor on wiper module assembly and reinstall all components back on vehicle.

4.3.2.14 Test Requirements. Refer to the program specific SSTS for test requirements. If there are no test requirements, use the following:

- Water path shall not allow water to drip water directly on to the wiper linkage nor the motor.
- Water Level in the plenum shall not touch the wiper linkage nor the motor.
- Water not allowed to submerge the wiper motor.
- Verify no water has entered the wiper motor.

4.3.3 Underhood Evaluation. The purpose is to verify AIP and other sealing components do not allow water paths into the underhood compartment that may be detrimental to the performance of any underhood and plenum mounted components.

4.3.3.1 Open vehicle hood and place video camera in rear corner of engine compartment so camera is aimed from driver side to passenger side of vehicle showing front edge of air inlet panel and hood seal interface to check for leaks. Example of camera positioning can be found in Appendix C, Figure C4.

4.3.3.2 Place vehicle in UWTB and turn off its underbody nozzles so any leaks can be seen during the test. With the HVAC blower off, start eight (8) minute water test and video record the first 30 s and last 30 s of the test. Monitor water drain path, if any, into the engine compartment, especially in the following interface areas:

- Hood Seal to Hood
- Hood Seal to AIP
- AIP to Plenum Extension
- Plenum Extension to Sheet Metal Structure
- Outboard Muckets to Hood Seal
- Muckets to Hood
- Muckets to Structure
- AIP Fasteners
- AIP to Windshield on Plenum-less Architectures
- Wiper Post Grommets on Plenum-less Architectures

4.3.3.3 Reposition video camera equipment in rear corner of engine compartment so camera is aimed from passenger side to driver side of vehicle.

4.3.3.4 With the HVAC blower off, start eight (8) minute water test and video record the first 30 s and last 30 s of test. Monitor water drain path, if any, into engine compartment.

4.3.3.5 Save videos and load into GDM so they can be referenced in evaluation report.

4.3.3.6 While still in UWTB, remove camera and tape from BAI opening. Reinstall all components so vehicle is back to design intent.

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4.3.3.7 Open vehicle hood and set garden hose volume to 30 L/minute (8 gal/minute) to understand where the water is draining during UWTB. From side of vehicle, slowly move hose across top of windshield, keeping hose end approximately 15 cm (6 in) away, and monitor water drain paths around AIP. Record 30 s of main water drain paths and capture any potential concerns with video camera.

4.3.3.8 Save the videos and load them into GDM so they can be referenced in an evaluation report, and note any findings on Data Sheet A1 of Appendix A.

4.3.3.9 Test Requirements .Refer to the program specific SSTs for test requirements. If there are no test requirements, use the following:

- Water path shall not allow water to enter the under hood compartment.

4.3.4 Roof Mounted Spray Bar. Test purpose is to aid in the determination of water leak paths under different rainfall conditions.

4.3.4.1 Preparation. Start with a dry clean test vehicle. One (1) or more observers should be outside the vehicle during test to inspect and record any visible water paths.

4.3.4.2 Close all doors and rear end closures or hatch. With engine running, cycle all windows down, and to fully closed position.

4.3.4.3 Remove the wiper arms and AIP from the vehicle. Ensure that all surfaces below the AIP are dry and free of debris (dry with towels and/or compressed air, if needed). Apply any components of concern within the wiper module water management path not currently assembled to the test vehicle (as referenced in 3.2.6).

4.3.4.4 Mount a camera (or cameras if needed) and lighting in the vehicle as needed. Take pictures of the pretest setup, focusing on the entire plenum area, motor, electrical connections, ball joints, components of concern near the wiper module water management path, and any other desired areas.

Note: Make sure final camera position, lighting, and wiring, will not be damaged when the wiper system is operating.

4.3.4.5 Apply the water feeling paste (3.2.6) to the wiper module motor, electrical connector, near each ball joint, on any components of concern near the wiper module water management path, and any other desired area. Make sure to apply the paste in small dots (no larger than 12 mm) separated by at least 2 mm, and as even with the surface as possible, so that water cannot travel along the paste and create false water paths. (Refer to Appendix E, Figure E1 or Figure E2 for example) .If the components listed are not within reach without disassembly, apply the water feeling paste to areas where potential water paths could develop towards these components. Add a vertical line of water feeling paste dots to understand water height in the plenum (avoid applying to areas where obvious water paths could occur and confuse results).

4.3.4.6 Replace the wiper arms and AIP back onto the vehicle. Cycle the wiper arms to verify that they come to rest in the proper park position. Leaving the hood up on the vehicle may assist in root cause, unless doing so negatively impacts the water flow anywhere in the areas of concern.

4.3.4.7 Connect the metered hose to the roof mounted fine adjustment spray bar (see Appendix E, Figure E3). Adjust the metered hose (as referenced in 3.1.3.2) to deliver approximately (~) 0.75 L/minute (0.2 gal/minute). Ensure that the spray bar is aimed correctly at the windshield, covering the entire width. With the water on, this step of the test should be conducted for a minimum of two (2) minutes, or when a steady state of water flow is observed by a camera inside of the plenum, for more than one (1) minute. The objective is to emulate a very light rainfall.

4.3.4.8 Operate the wipers at a low setting appropriate to the amount of water on the windshield (such that no dry wipes occur). Continue operating the wipers for a minimum of two (2) minutes, or when a steady state of water flow is observed by a camera inside of the plenum for more than one (1) minute.

4.3.4.9 With the wipers still operating, turn on the HVAC blower motor to the maximum fan speed in order to affect air flow in the plenum. Continue operating the blower motor for a minimum of two (2) minutes, or when a steady state of water flow is observed by a camera inside of the plenum for more than one (1) minute.

4.3.4.10 At the conclusion of the test, immediately towel dry the windshield, hood, and AIP, as thoroughly as possible. It should be noted that compressed air must not be used, as it could blow water droplets through the AIP vent holes onto areas of the water feeling paste that would otherwise not be contacted by water (providing false test results). Carefully remove the wiper arms and AIP, noting any water that may be shed off of these components onto the water feeling paste during disassembly.

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