GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW3070

Performance Validation of Debris Ingestion for HVAC

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 validate the performance capability of a vehicle ventilation system to prevent ingestion of debris from both outside the vehicle as well as from the vehicle glove box (assuming close proximity of the glove box to the blower fan).

1.2 Applicability. All passenger vehicles with a ventilation system.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3058

2.3 Additional References.

- Design Failure Mode and Effect Analysis.
- Vehicle Technical Specification (VTS).

3 Resources

3.1 Facilities. Any area able to contain the vehicle to be tested with an exhaust extraction system, power supply, and the necessary test equipment.

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 One (1) airflow measurement device (airflow machine) capable of measuring and producing air flow ≥ 215 L/s.

3.2.2 Flexible tubing with inner diameters of at least 100 mm.

3.2.3 One (1) debris collection box (see Appendix A, Figure A1, Figure A2 and Figure A3 for description and photographs).

3.2.4 Three (3) cylindrical adapters made from metal sheets to connect the flexible tubing to the debris collection box (one on either side) and the blower scroll of the vehicle.

3.2.5 Shop vacuum for cleaning up debris.

3.2.6 Debris composed of approximately 100 g of small paper discs (paper hole punches, approximately 7 mm in diameter), thermal paper cash receipts, and tissue paper to simulate debris. See Figure 1 for pictures and specifications.

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Debris Composition and Type

7mm diameter x 0.1mm paper hole punches

1 to 1 or 2 to 1 length to height ratio of thermal paper 57mm to 80 mm in width and 50 to 60 grams / m^2 (GSM) in weight

Material:	Recycle paper
Ply :	2
GSM:	16(+/-1g)
Sheet length :	95mm(+/-2mm)
Sheet width:	95mm (+/-1mm)

Note: Left image is paper discs, center image is thermal paper, and the right image is tissue paper.
GSM Grams per meter squared (g/m^2).

Figure 1: Debris Composition and Type

3.3 Test Vehicle/Test Piece. Passenger vehicles equipped with a ventilation system.

3.4 Test Time.

Calendar time:	1 days
Test hours:	1 h
Coordination hours:	3 h

3.5 Test Required Information. Test conditions as specified by the Vehicle Technical Specification (VTS).

3.6 Personnel/Skills. Two (2) observers.

4 Procedure

4.1 Preparation.

4.1.1 The vehicle shall be prepared according to 3.2, 4.1.2, and 4.1.3.

4.1.2 If the vehicle ventilation is equipped with a cabin air filter as an option (not base content) or not at all, then the filter shall be removed from the vehicle during the test. As illustrated in Figure 2, Figure A1 and Figure A2, begin by removing the blower from the blower scroll and the filter (if not base content) and attaching one end of the flexible tubing to the blower scroll using the metallic cylindrical adapter. Connect the other end of the tube to the inlet side of the debris collection box. With another flexible tube, connect the outlet of the debris collection box to the airflow machine. The blower voltage and amperage are to be monitored and the test shall start when the amperage and voltage are constant.

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Figure 2: Particle Filter and Blower Motor Removed from HVAC, Hose Connected to Hole for Blower Motor

4.1.3 If the air inlet from the plenum to the HVAC module is equipped with a cabin air filter as base content, then the filter shall be remain during the test and the vehicle blower shall be used provided that the airflow path from both the plenum or from the glove box side goes through the filter. If air from either from the plenum or from the glove box should not go through the filter, then the debris collection box of 4.1.2 shall be used for the unfiltered path. The vehicle blower shall be turned to maximum blower. The vehicle voltage is to be monitored and the test shall begin when the blower voltage is constant. For vehicles with Brushless Direct Current (BLDC) blowers and integrated Pulse Width Modulated (PWM) controllers, the appropriate computer equipment or vehicle HVAC controls shall set the blower speed to maximum. If the integrity of the filter seal around the HVAC module housing should allow by-pass air, then 4.1.2 is to be used instead of 4.1.3.

4.1.3 If the vehicle ventilation is equipped with a cabin air filter as base content, then the filter shall be remain during the test and the vehicle blower shall be used. The vehicle filter either shall be used to collect the debris if the air path, starting either from the plenum (4.3.1) side or from the glove box side (4.3.2), goes through the filter. If the air path starts either from the plenum or from the glove box and does not go through the filter, then the debris collection box of 4.1.2 shall be used for the unfiltered path. The blower shall be turned to maximum blower. The vehicle voltage is to be monitored and the vehicle shall idle until the blower voltage is constant. If there is some question about the integrity of the filter seal around the HVAC module housing to allow by-pass air, then 4.1.2 is to be used instead of 4.1.3. The Design Failure Mode and Effect Analysis (DFMEA) pass/fail logic decision tree of Appendix C Figure C1 must be followed.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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 Vehicle Conditions.

- Windows: Down.
- Air direction: In Face mode with air coming out of instrument panel outlets.
- Hood: Down.
- Recirculation and Outside Air Door/Mode: See 4.3.
- Blower: See 4.1.
- Temperature: Full cold.

4.2.2.2 Electrical Power Supply. Not applicable.

4.3 Instructions.

4.3.1 Test Description - Plenum Ingestion.

a. Keep the vehicle in Outside Air Mode (OSA) (recirculation door in closed position). Start the airflow and let the blower (in either 4.1.2 or 4.1.3) voltage stabilize.

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