



Aero Shutter Assembly Cycle Durability 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. The purpose of this standard is to determine if an aero shutter assembly meets the cycle durability requirements of the Component Technical Specification (CTS).

1.2 Applicability. For all aero shutter assemblies.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ISO 12103-1

2.2 GM Standards/Specifications.

GMW3221

2.3 Additional References.

- Component Technical Specification (CTS)

3 Resources

3.1 Facilities.

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 Environmental Chambers. Environmental chambers capable of maintaining temperatures from -30 °C to +105 °C and large enough to test multiple aero shutter assemblies at one time.

3.2 Equipment.

3.2.1 Software. Software and interfacing hardware shall be provided by the actuator supplier that includes the operating parameters for the actuator and can be used with a personal computer.

3.2.2 Pulse Width Modulation (PWM) or Local Interconnect Network (LIN) Generator. PWM and/or LIN generators are required to allow the software to send a signal to the actuator to cycle the aero shutter assembly and send a signal back through the software that the aero shutter assembly was able to successfully cycle. The test engineer needs to verify the correct generator to use on each program with the responsible designing engineer.

3.2.3 Battery Source (12 V). A 12 V battery source is required to power the actuator.

3.2.4 Temperature Measurement. A contactless infrared pyrometer is required to measure surface temperature.

3.2.5 Camera. A camera is required for (pre and post) test photographs.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Piece. The parts used for Design Validation (DV) testing shall be complete aero shutter assemblies off of prototype tools. The parts used for Product Validation (PV) shall be complete aero shutter assemblies off of production tools.

3.3.2 Test Piece Quantity. Per CTS.

3.3.3 Conditioning. Conditioning to GMW3221, Code A.

3.4 Test Time. For one life:

Calendar time: 60 d

Test time: 1440 h

Coordination time: 8 h

3.5 Test Required Information.

3.5.1 Test Setup Photographs. Take photographs of the test setup prior to start of test.

3.5.2 Part Photographs. Take photographs of the part to be tested prior to start of test, in the event of a failure, and at end of test.

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 in 3.5.

4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Temperatures. Test shall be run at ambient, humid, hot, and cold temperatures per the CTS.

4.2.1.2 Arizona Dust. Arizona dust is applied at cycle increments per the durability schedule located in the test instructions (4.3). The Arizona dust is mixed with water and transmission oil at the ratio specified in Table 1 to create a paste. This paste is evenly distributed with a brush at each interface of moving louvers and linkages. An example of the locations to apply the Arizona dust is provided in Figure 1. The green circles represent the application locations.

Table 1: Ratio of Arizona Dust, Water, and Transmission Oil

Substance	Ratio
Arizona Dust - ISO 12103-1, A2 (fine)	5 g
Water	10 g
Transmission Oil	0.5 g



Figure 1: Example of Locations to Apply Arizona Dust

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.

4.2.3 Test Piece Constraints. The aero shutter assembly is to be securely constrained to a test fixture representing all vehicle attachments and positioned in vehicle orientation. An example is provided in Figure 2.

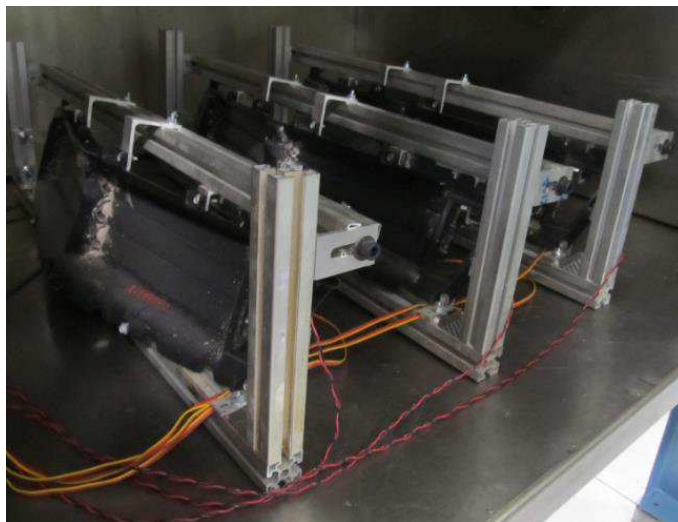


Figure 2: Example of Test Setup

4.3 Instructions.

4.3.1 Pre-Test Instructions.

4.3.1.1 Confirm Test Connections. Confirm the following connections have been made correctly: Personal computer to generator, 12 V battery source to generator, and generator to actuator.

4.3.1.2 Cycle Definition. A cycle is defined as follows: starting with the shutters in the full open position, move the shutters to the fully closed position, and then back to the fully open position.

4.3.1.3 Confirm Aero Shutter Assembly Actual Operating Angle. For each test sample, record the actuator travel angle (angular distance between end stops plus physical tolerance stack up of the system and component). Use 3 cycles to determine the average of the actuator travel angle. Record in Data Sheet A1. The supplier shall work with the GM validation engineer to comprehend this requirement.

4.3.1.4 Confirm Test Operation. Cycle the aero shutter assembly through at least ten cycles to ensure proper operation of all system components. Note any irregular sounds or erratic operations indicating a potential problem with assembly or design, and verify observations with the requesting engineer. Confirm that there are no issues with the test setup and that signals are being sent and received through the software provided by the actuator supplier. Also, confirm that the operating angle is being recorded for each cycle.

4.3.1.5 Adjust Calibration Angle (if needed). For both DV and PV level testing, the actuator travel angle must be measured before and after durability testing to ensure the designed calibration angle is within tolerance. The aero shutter supplier is responsible for ensuring the calibration angle is adjusted to the actual (test parts) actuator travel angle per the CTS requirement. Example: Actuator Design travel angle = 90°, actual DV test part actuator travel angle = 100°. Actuator travel angle tolerance = -10°/+40°. Actuator calibration angle would need to be re-flashed to 90° to 140° prior to start of test.

4.3.2 Test Instructions. The same aero shutter assembly is to be used for each environment of this test.

4.3.2.1 DV Durability Schedule. See Table 2. Aero shutter assembly must be at the specified temperatures before the start of each test sequence.

4.3.2.2 PV Durability Schedule. See Table 3. Aero shutter assembly must be at the specified temperatures before the start of each test sequence.

4.3.2.3 Dwell (Pause) Time between Cycles. Dwell times may be dependent on environment. For room temperature testing, no dwell time is required between open/close cycles. During hot temperature testing, potential overheating of internal actuator components may occur due to continuous cycling, therefore, increased

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