



Active Spoiler Test Procedure

1 Introduction.....	4
1.1 Purpose.	4
1.2 Applicability.....	4
1.3 Remarks.	4
2 References	4
2.1 External Standards/Specifications.....	4
2.2 GM Standards/Specifications.	4
2.3 Additional References.	4
3 Resources	5
3.1 Facilities.....	5
3.1.1 Calibration.....	5
3.1.2 Alternatives.	5
3.2 Equipment.	5
3.2.1 Thermal chamber.....	5
3.2.2 Fixtures.	5
3.2.3 Power Supply.....	5
3.2.4 Water Supply.	5
3.2.5 Digital camera.	5
3.2.6 Force gauge with hook attachment.....	5
3.2.7 Electric motor dynamometer.....	5
3.2.8 Output shaft holding fixture.....	5
3.2.9 Measuring scale/ruler.....	5
3.2.10 Cycle counter/encoder.....	5
3.2.11 Oscilloscope.....	5
3.2.12 Temperature measuring equipment.....	5
3.2.13 Variable pressure arms (tip force/arm load).	5
3.2.14 Accelerometer.....	5
3.2.15 Vibration/Shock Machine.	5
3.2.16 Wire Harness.	5
3.2.17 Vehicle.	5
3.3 Test Vehicle/Test Piece.....	5
3.3.1 Test samples shall be	5
3.3.2 Unless otherwise specified, three samples of components or systems shall be tested.....	5

3.3.3 All components/systems used in testing shall	5
3.4 Test Time.....	5
3.5 Test Required Information.....	5
3.5.1 Load magnitude and directions.....	6
3.5.2 Load application location.	6
3.5.3 Environmental conditions.....	6
3.5.4 Wet-out force for spoilers attached to the closure panel.	6
3.5.5 Spoiler to closure panel attaching bolt and/or nut torques.	6
3.5.6 Number of repetitions.....	6
3.5.7 Any special paint/bake process of the spoiler prior to test.	6
3.5.8 Notification.	6
3.5.9 Five (5) Phase – CG180.	6
3.5.10 Product Security.....	6
3.6 Personnel/Skills.....	6
3.6.1 Sound Evaluators.....	6
4 Procedure.....	6
4.1 Preparation.....	6
4.1.1 Test Piece Constraints.....	6
4.1.2 Test Pull Locations.....	6
4.2 Conditions.....	6
4.2.1 Environmental Conditions.	6
4.2.2 Test Conditions.....	7
4.3 Instructions.....	7
4.3.1 Sample Inspection.....	7
4.3.2 Sample Preparation.....	7
4.3.3 Facilities and Equipment Preparation.....	7
4.3.4 Test Operation Instructions.....	8
4.3.5 Post-Test Instructions.....	8
4.3.6 Preparation.....	8
4.3.7 Active Spoiler System Electronic Component Specification Testing.....	9
4.3.8 Active Spoiler System Ultra Violet (UV) Exposure Testing.....	9
4.3.9 Sound Quality Determination.....	9
4.3.10 High Speed Reliability in Vehicle.....	9
4.3.11 Motor Stall/Thermal Trip.....	10
4.3.12 Durability/Reliability.....	11
4.3.13 Hot Temperature Operation.....	13
4.3.14 Cold Temperature Operation.....	14
4.3.15 Hot Storage Testing.....	14
4.3.16 Cold Storage Testing.....	15
4.3.17 Free Fall.....	15

4.3.18 Mechanical Shock (Pothole).....	16
4.3.19 Mechanical Shock (Vehicle Collision).....	18
4.3.20 Random Vibration.	19
4.3.21 Parade Rider.....	20
4.3.22 Deck Lid Slam.....	21
4.3.23 System Operating Time Capability.	21
4.3.24 Hold Open Capability.....	21
4.3.25 Restricted Open Operation Performance.	22
4.3.26 Restricted Closed Operation Performance.....	22
4.3.27 Electromagnetic Compatibility (EMC).....	22
4.3.28 Material Performance.	23
4.3.29 Corrosion Performance.....	24
4.3.30 Vehicle Level Testing.....	24
4.3.31 Material Guidelines.	25
5 Data.....	25
5.1 Calculations. Not applicable.	25
5.2 Interpretation of Results.	25
5.3 Test Documentation.	25
5.3.1 Test Results.....	26
5.3.2 Evaluation Reports.....	26
6 Safety.....	26
7 Notes.....	26
7.1 Glossary.....	26
7.2 Acronyms, Abbreviations, and Symbols.....	27
8 Coding System.....	28
9 Release and Revisions.....	28
Appendix A: Suggested Test Flow.....	29
Appendix B.....	32
B1 Power Operated Sounds - Power Operated Sound Attributes.....	33
B1.1 Start Loudness.....	33
B1.2 Stop Loudness.....	33
B1.3 Motor Speed (Pitch) Variation.....	33
B1.4 Warble.....	33
B1.5 Scraping.....	33
B1.6 Loudness.....	33
B1.7 Whine.....	33
B1.8 Buzz.....	33
B1.9 Harshness, Roughness, Repetitive Transients, Transients.....	33
B1.10 Gravelly.....	34

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 standard defines the testing methodology and requirements for validating Active Spoiler systems to GM requirements. Active Spoiler system components include:

- Active Spoiler - motor/transmission.
- Active Spoiler - electrical components and connections.
- Spoiler - any attaching hardware.

1.2 Applicability. This standard applies to all passenger cars, Multipurpose Passenger Vehicles (MPV), and trucks that have an active spoiler system.

1.3 Remarks. This document is the GM Worldwide Active Spoiler Testing Standard. Its purpose is to establish a common test methodology for Active Spoiler 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 Roof Closure Global Subsystem Leadership Team (GSSLT).

2 References

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

2.1 External Standards/Specifications.

ISO 1043	ISO 11469	SAE J903	SAE J1344
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2.2 GM Standards/Specifications.

GMW3059	GMW8518	GMW14872	GMW15730
GMW3091	GMW14101 (ID)	GMW15016	GMW15777
GMW3097	GMW14153	GMW15264	GMW16156
GMW3103	GMW14444	GMW15308	GMW16300 (ID)
GMW3116	GMW14527	GMW15332 (ID)	GMW16301 (ID)
GMW3172	GMW14528	GMW15443	GMW16302 (ID)
GMW3232	GMW14529 (ID)	GMW15470 (ID)	GMW16303 (ID)
GMW3600	GMW14650	GMW15531	GMW16679
GMW8463	GMW14797	GMW15576	

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

2.3 Additional References. Some of these references are internal GM documentation. Suppliers should work with the responsible GM engineer to comprehend these requirements.

- CG180 5-Phase Template
- CG3044 Supplement to GMW3103 Appendix A Test Plan
- Component EMc and ENvironmental Test Database (CEMENT)
- Dimensional Technical Specifications (DTS)
- GM Research and Development (R&D) Report AS-598, "Hearing Acuity Standard for Squeak and Rattle Evaluators"
- GM Security Guidelines - (<https://gmweb.gm.com/HR/Security/Pages/FutureGuide.aspx>)
- GM1829 Analysis Development Validation Plan and Report (ADVP&R) which is located in the Subsystem Technical Specification (SSTS)
- IHS Incorporated - (<https://www.ihs.com/index.html>)
- Milford Proving Ground Weather Report
- Program Specific Component Technical Specification (CTS)
- Program Specific SSTS
- Vehicle Technical Specifications (VTS)

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October 2016

Page 4 of 34



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3 Resources

3.1 Facilities. Environmental chambers large enough to accommodate the test vehicle and capable of -40 °C to +95 °C temperature.

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 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.

3.2.2 Fixtures. Body test buck consisting of Body-In-White (BIW), Rear Closure, Bumper and Fascia.

3.2.3 Power Supply. Electrical power supply device that reflects vehicle electrical interface (mating connector, wire gage, control box, etc.)

3.2.4 Water Supply. Water spray equipment/nozzle according to SAE J903, Section 5.2.2 c (820 cm³/minute minimum).

3.2.5 Digital camera.

3.2.6 Force gauge with hook attachment.

3.2.7 Electric motor dynamometer.

3.2.8 Output shaft holding fixture.

3.2.9 Measuring scale/ruler.

3.2.10 Cycle counter/encoder.

3.2.11 Oscilloscope.

3.2.12 Temperature measuring equipment.

3.2.13 Variable pressure arms (tip force/arm load).

3.2.14 Accelerometer.

3.2.15 Vibration/Shock Machine. Electromagnetic oscillation table with control unit for oscillation test.

3.2.16 Wire Harness. Wiring harness capable of running the Active Spoiler system from outside the vehicle/buck.

3.2.17 Vehicle.

3.3 Test Vehicle/Test Piece.

3.3.1 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.

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

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

3.4 Test Time. Time is dependent on test being performed.

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested (reference Vehicle Technical Specifications/Subsystem Technical Specifications (VTS/SSTS) paragraph numbers if applicable, see 2.3).

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October 2016

Page 5 of 34

Testing worst case scenarios may uncover some potential problems. Discuss with the requesting engineer if testing should include some worst case scenarios. Depending on which test is being performed and which level of parts or systems is being tested, consider if any of the following may apply: tolerance stackups, build variations, misalignment, minimum/maximum fastener torque(s), lubrication, environmental extremes, location of customer representative load application, symmetry (left hand vs. right hand), color, mold or die source, etc. The following specifications or information are required to run this test:

3.5.1 Load magnitude and directions.

3.5.2 Load application location.

3.5.3 Environmental conditions.

3.5.4 Wet-out force for spoilers attached to the closure panel with tape only. This force is to be provided by the requesting engineer and for most applications is approximately 67 N (15 lb).

3.5.5 Spoiler to closure panel attaching bolt and/or nut torques.

3.5.6 Number of repetitions.

3.5.7 Any special paint/bake process of the spoiler prior to test.

3.5.8 Notification. GM Validation shall be notified of test failures within 24 h period of occurrence.

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

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

3.6 Personnel/Skills.

3.6.1 Sound Evaluators.

3.6.1.1 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 (R&D) Report AS-598, "Hearing Acuity Standard for Squeak and Rattle Evaluators."

3.6.1.2 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.

4 Procedure

4.1 Preparation. Refer to Figure A1 and Figure A2 to understand the test sequencing for all test samples included in this procedure. This is only a suggested test flow to help optimize test samples.

This standard has been developed to reflect customer usage for markets which have developed road systems (more stable road systems and lesser amounts of unpaved and rough roads). Other regional or local requirements may necessitate additional test options. For further information, consult regional Engineering Center.

4.1.1 Test Piece Constraints. Spoiler outer is to be securely constrained to test apparatus with bolts or clamps without changing the shape of the part.

4.1.2 Test Pull Locations. Attach pull equipment to the spoiler inner at two dog house openings equidistant from centerline and close to the rearward edge of the spoiler assembly.

4.1.2.1 This can be done by drilling through the Class A surface of the spoiler in the dog house locations and securing bolts to a metal pull bar.

4.2 Conditions. Symbol definitions required for test methods contained in this procedure are listed in Section 7. Actual requirement values for the symbols shall be obtained from the SSTs or the respective specification and recorded in the test report.

The driving test can be performed in all types of weather. However, in situations where severe weather makes certain driving maneuvers unsafe, Test Procedure Subsections using those maneuvers shall be postponed until road conditions improve.

4.2.1 Environmental Conditions. The following conditions apply to all tests unless otherwise specified:

- Ambient temperature: $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.
- Voltage: $V_{nom} \pm 0.3\text{ V}$ at motor terminals.
- Humidity shall be 50% to 75% for all tests unless otherwise specified.
- T_{min} is $-40\text{ }^{\circ}\text{C}$ unless otherwise specified.

- $T_{\max}$ is +85 °C unless otherwise specified.

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 from the requirements of this standard shall have been agreed upon between GM Subsystem Validation Engineer (SVE) and/or Design Engineer (DE) and the supplier. Deviations shall be approved by the GM Validation Engineer and specified on the GM1829 Analysis Development and Validation Plan and Report (ADVP&R) and all effected test reports. The deviations to SSTS requirements shall be documented with the DE.

4.2.2.1 Fasteners. Nominal fastener torques shall be used unless otherwise specified. Unless otherwise specified, use a dynamic gun at 50 min⁻¹ (rpm) to dynamically torque the nut for all tests.

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

4.2.2.2 Water Hardness. Verify that the hardness of the water does not exceed 205 mg/L (12 grains/gal). The water hardness certification may be obtained from the local water supplier. Otherwise, contractor shall obtain an equivalent certification or conduct such test within 60 days of beginning of compliance test run. A suitable water softener shall be used if required.

4.2.2.3 Emerging Market Environmental Conditions. Emerging Markets are to use the following unless stated otherwise in the program specific SSTS.

- $T_{\min}$ = -20 °C for India.
- $T_{\min}$ = -40 °C for Russia.
- $T_{\min}$ = -15 °C for South America only.

4.3 Instructions.

4.3.1 Sample Inspection. The test and requesting engineers should inspect the test items to insure all material listed in 3.3 is of correct design level and assembled properly. Check for cracks, paint chips, dents, etc., and document for comparison to post-test observations (see 4.3.3.2).

4.3.2 Sample Preparation. This test is normally run on the test subject in an as-received condition. If it is requested to be run in a specifically adjusted condition, follow the applicable procedure(s).

4.3.3 Facilities and Equipment Preparation. Record the instrumentation calibration information on the attached Calibration Data Sheet A1 or an equivalent document.

4.3.3.1 Tape Applied Spoiler. Per the Master Product Document (MPD) remove the release liner from the tape and position the spoiler on the closure panel using available locating features. While holding the spoiler in position, apply the wet out force per 3.5.4 to the entire surface area of the spoiler using the roller (An adjustable clutch roller is required to manually wet-out spoilers attached to the closure panel with tape only). After installation, the spoiler should dwell at ambient temperature for a minimum period of 72 h before testing to allow the tape adequate cure time. Note on the data sheet any concerns observed during assembly.

4.3.3.2 Fastened Spoiler. Attach the spoiler to the closure panel and torque the fasteners to the specifications provided in the Master Product Document (MPD) or as specified in the program specific SSTS/Component Technical Specification (CTS). Note on the data sheet any concerns observed during assembly (i.e., audible crack while the fasteners are being torqued or closure panel deformation).

4.3.3.2.1 Measure the gaps and flushness of the spoiler to the closure panel at the locations defined by the Dimensional Technical Specifications (DTS).

4.3.3.2.2 Position the closure panel on the portable structure plate in approximate body position. Restrain the panel in position. Typically, several clamping locations on the lead and trailing edges are used.

4.3.3.2.3 Attach the load cell and loading fixture to the actuator. Position the loading fixture on the spoiler at the location and orientation specified by the requesting engineer (3.5.1 and 3.5.2). Rigidly fix the actuator in this position and fasten it to the portable structure plate. **Note:** The actuator should be positioned to the midpoint of its full travel prior to attachment.

4.3.3.2.4 Verify there is no load being applied to the spoiler. Calibrate the load cell and zero the load.

4.3.3.2.5 Set up the plotter to graph load vs. time.

4.3.3.2.6 Move the test setup into the appropriate environmental chamber and allow a minimum soak time of 4 h.

4.3.4 Test Operation Instructions. Note: In some cases, the spoiler design may prevent a person from gripping the forward edge of the spoiler to apply a rearward load. Use the appropriate test operation described in 4.3.4.1 or 4.3.4.2.

4.3.4.1 Fore/Aft Loading. Apply a forward load to the rear edge of the spoiler. The loading fixture should be moved slowly (approximately 10 mm/s) until the fixture contacts the spoiler to avoid impact loading of the spoiler. Continue to apply the load at the same rate until the specified load level is obtained. Hold the load at the specified level for 15 s. After 15 s, reverse the actuator to apply a rearward load to the front edge of the spoiler. Again, the load should be applied slowly (approximately 10 mm/s) to avoid impact loading of the spoiler and should again be held for 15 s. This sequence should be repeated a total of twenty five times unless otherwise specified from the requesting engineer. While conducting these cycles, a graph of load vs. time should be generated to document load magnitudes, directions (forward vs. aft) and durations. **Note:** The load magnitudes for this test should be specified by the requesting engineer or in the program specific CTS/SSTS. Traditionally the load magnitudes have been 500 N for the forward load and 450 N for the rearward load. However check the program specific SSTS/CTS for actual program loads,

4.3.4.2 Forward Load Only. In the case where the spoiler design prevents a person from gripping the forward edge of the spoiler to apply a rearward load, apply only the forward load as described in 4.3.4.1.

4.3.4.3 Vertical (Upward) Loading. Position the actuator in a vertical orientation directly below the spoiler trailing edge. Ensure the load direction is perpendicular to the spoiler surface, (this may require adjusting the load direction from the nominal z-axis), record this angle deviation. Apply an upward vertical load to the lower surface of the spoiler. The loading fixture should be moved slowly (approximately 10 mm/s) until the fixture contacts the spoiler to avoid impact loading of the spoiler. Continue to apply the load at the same rate until the specified load level is obtained. Hold the load at the specified level for 15 s. After the load is held for 15 s, the load is removed for 15 s. This sequence should be repeated a total of 25 times, unless otherwise specified from the requesting engineer. While conducting these cycles, a graph of load vs. time should be generated to document load magnitudes, directions and durations. **Note:** The load magnitudes for this test should be specified by the requesting engineer or in the program specific CTS/SSTS. Traditionally the load magnitude for spoiler vertical loading in the upward direction has been 450 N total.

4.3.4.4 Vertical (Upward) Loading. In the case where the spoiler design prevents a person from gripping the underside of a spoiler to apply an upward vertical force, the upward vertical test is not required.

4.3.4.5 Vertical (Downward) Loading. Position the actuator in a vertical orientation directly above the spoiler. Apply a downward vertical load to the upper surface of the spoiler. The loading fixture should be moved slowly (approximately 10 mm/s) until the fixture contacts the spoiler to avoid impact loading of the spoiler. Continue to apply the load at the same rate until the specified load level is obtained. Hold the load at the specified level for 15 s. After the load is held for 15 s, the load is removed for 15 s. This sequence should be repeated a total of 25 times, unless otherwise specified from the requesting engineer. While conducting these cycles, a graph of load vs. time should be generated to document load magnitudes, directions and durations. **Note:** The load magnitudes for this test should be specified by the requesting engineer or in the program specific CTS/SSTS. Traditionally the load magnitude for spoiler vertical loading in the downward direction has been 535 N.

4.3.4.6 Allow the tested system to rest for at least 4 h and then inspect the spoiler and closure panel for any permanent distortion, fit of the spoiler to the closure panel, cracks or separation. **Note:** Blow molded spoilers may recover to their original shape over the rest period.

4.3.4.7 Repeat 4.3.4.1, 4.3.4.3, and 4.3.4.5, for other load application locations or environmental conditions.

4.3.5 Post-Test Instructions. Note: Every post-test operation/measurement/inspection must typically have a pre-test equivalent to have any meaning or significance. A crack detected at the end of test means nothing unless there is pre-test documentation verifying no crack existed prior to the start of test.

4.3.5.1 Include a sketch, marked drawing or photograph showing the load application location(s).

4.3.5.2 Document on the sketch, drawing or photograph, any areas of permanent deformation, cracks, and change in fit (gaps/flushness) between the spoiler and the closure panel or separation (loss of attachment) of the spoiler to the closure panel.

4.3.6 Preparation.

4.3.6.1 Test Piece Constraints. Spoiler outer is to be securely constrained to test apparatus with bolts or clamps without changing the shape of the part.

4.3.6.2 Test Pull Locations. Attach pull equipment to the spoiler inner at two dog house openings equidistant from centerline and close to the rearward edge of the spoiler assembly.

4.3.6.2.1 This can be done by drilling through the Class A surface of the spoiler in the dog house locations and securing bolts to a metal pull bar.

4.3.6.3 Instructions.

4.3.6.3.1 The spoiler assembly shall be supported as in 4.3.1.

4.3.6.3.2 The spoiler assembly shall be pulled at a rate of 50 mm/minute until there is separation between the spoiler inner and outer.

4.3.7 Active Spoiler System Electronic Component Specification Testing.

4.3.7.1 Purpose. To verify the environmental and durability performance of electronic components in the Active Spoiler system.

4.3.7.2 Equipment. Reference GMW3172.

4.3.7.3 Sample Size. Samples of each electronic component as specified in the procedure (includes drive motors, electronic control units, integral switches, etc.)

4.3.7.4 Procedure. Test to GMW3172. Approval of a Component Environmental Test Plan for each electronic device is required.

4.3.7.5 Acceptance Criteria. Samples shall pass post-test requirements as defined in the Component Environmental Test Plan, per requirements defined in the SSTs or the respective specification. Record all results per GMW3172.

4.3.8 Active Spoiler System Ultra Violet (UV) Exposure Testing.

4.3.8.1 Purpose. To determine if the Active Spoiler subsystem will incur damage when subjected to simulated sunlight, heat, and moisture.

4.3.8.2 Equipment. Reference 4.3.8.4.

4.3.8.3 Sample Size. Samples of each component as specified in the procedure. Samples are to be plaque-sized sections cut from a production representative or production Active Spoiler system, containing the interface to be tested. One sample of each condition outlined in the noted procedures is to be tested.

4.3.8.4 Procedure. Test to GMW14650, and/or GMW14444 as noted in the technical requirements.

4.3.8.5 Acceptance Criteria. Samples shall meet requirements as defined in the SSTs or other respective specification.

4.3.8.6 Record All Results in an independent test report.

4.3.9 Sound Quality Determination.

4.3.9.1 Purpose. To evaluate the noise of a power Active Spoiler system when mounted on a fixture.

4.3.9.2 Equipment. Reference GMW14153.

4.3.9.3 Sample Size. Durability and Reliability samples may be used to fulfill requirement or, test three new samples.

4.3.9.4 Procedure. Test to GMW14153.

4.3.9.5 Acceptance Criteria. Samples shall meet requirements as defined in the SSTs or other respective specification.

4.3.9.6 Record all results in an independent test report per GMW14153.

4.3.10 High Speed Reliability in Vehicle.

4.3.10.1 Purpose. To determine the maximum deflection of the Active Spoiler during high speed vehicle operation.

4.3.10.2 Equipment.

4.3.10.2.1 Vehicle capable of vehicle maximum speed.

4.3.10.2.2 Laser Instrumentation.

4.3.10.2.3 Ammeter.

4.3.10.3 Sample Size. Minimum of one (1) vehicle shall be tested.

4.3.10.4 Procedure. Prepare the vehicle with equipment to measure the deflection of the Active Spoiler during high speed driving.

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October 2016

Page 9 of 34

4.3.10.4.1 Take the vehicle to the circular test track. Turn on deflection measurement equipment and start to record speed, deflection and time. Record via laser instrumentation setup the displacement of the mid front edge of the Active Spoiler.

4.3.10.4.2 Proceed to increase speed from 0.0 km/h to maximum vehicle speed.

- Record vehicle speed on the circular track in km/h (mph).
- Record vehicle relative speed using instrumentation borrowed from an instrument lab.
- Record the differential pressure (ΔP) between the inside vehicle compartment and outside pressure while the HVAC system vents are closed.
- Record the wind speed and direction during the high-speed testing time on the Circular Track. This data is available from the Milford Proving Ground Weather Report.

4.3.10.4.3 Create plot of data collected as in Figure 1.

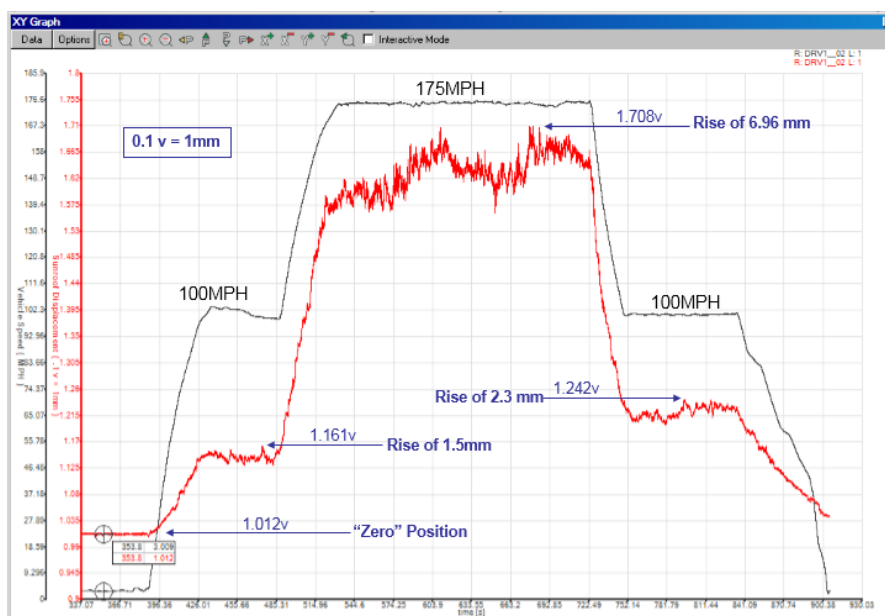


Figure 1: Example of Active Spoiler Displacement Plot

4.3.11 Motor Stall/Thermal Trip.

4.3.11.1 Purpose. The purpose of this test is to verify that the Active Spoiler motor will not be damaged if the Active Spoiler system is activated with an obstruction and not able to move for an extended period of time.

4.3.11.2 Test Equipment. See Section 3.2.

4.3.11.2.1 Electric motor dynamometer.

4.3.11.2.2 Output shaft holding fixture.

4.3.11.3 Test Samples. Two motors.

4.3.11.4 Test Preparation. See Section 4.1.

4.3.11.5 Test Conditions.

- 30 °C ± 3 °C.
- +80 °C ± 3 °C.

4.3.11.6 Test Procedure. Prior to test, subjectively evaluate the system noise (including but not limited to whine, growl, clicks, clunks, etc.) per Subjective Rating Scale for Component Noise in Table B1 under the following conditions: V_{nom} , no load.

4.3.11.6.1 Mount each motor to a dynamometer and run at V_{nom} with a 2.5 N·m constant load for 30 minutes. After warm up period, obtain motor performance via a speed-torque curve from free speed to stall. Allow motors to cool for 1 h before start of test.

4.3.11.6.2 Place first motor sample in holding fixture with output shaft restricted.

4.3.11.6.2.1 Condition. Soak motor at $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 4 h.

4.3.11.6.2.2 At $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, energize restricted motor in high speed for 3 h.

4.3.11.6.2.3 De-energize motor and continue to soak at $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for additional 2 h.

4.3.11.6.2.4 At $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, energize restricted motor in low speed for 3 h.

4.3.11.6.3 Repeat 4.3.11.6.2 thru 4.3.11.6.2.4 on second motor sample except change thermal temperature to $+80\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

4.3.11.6.4 Upon completion of stall conditions, allow for cool-down period of at least 4 h. After cool-down period, record motor performance via a speed-torque curve from free speed to stall.

4.3.11.6.5 Repeat motor noise evaluation described in 4.3.11.6 on both motors.

4.3.11.7 Test Requirement. Both high and low Active Spoiler motor speeds with 2.5 N·m load shall not degrade more than 10% from initial speed OR torque as specified in the program specific SSTs.

4.3.11.7.1 Active Spoiler motor low speed stall torque shall not degrade more than 10% from design torque OR speed as specified in the program specific SSTs.

4.3.11.7.2 Active Spoiler motor current draw for both low and high speeds shall be within design specification. Document the current draw under all conditions.

4.3.11.7.3 Initial motor noise Subjective Rating shall be 9 or better and after test it shall be 8 or better per Subjective Rating Scale for Component Noise in Table B1. Check the program specific SSTs for additional requirements.

4.3.12 Durability/Reliability.

4.3.12.1 Purpose. The purpose of this test is to verify an Active Spoiler system will meet specified performance requirements during a vehicle's lifetime with reliability (R) and confidence (C) level of R95C50 at one life. One life is defined in program SSTs.

4.3.12.2 Test Equipment. See Section 3.2.

4.3.12.2.1 Cycle counter/encoder.

4.3.12.2.2 Oscilloscope.

4.3.12.2.3 Thermal chamber.

4.3.12.3 Test Samples. See 3.3, three samples minimum.

4.3.12.4 Test Preparation. See Section 4.1.

4.3.12.4.1 If GM validation engineer is not available to view test, provide video record showing test setup and initial system operation.

4.3.12.4.2 Reliability requirement can be met through either Success or Failure Testing. Review with GM Validation Engineer and get agreement on which method will be used before start of test.

4.3.12.4.2.1 Failure Test. Required unless specifically stated in the program specific SSTs for DV Testing. Repeat durability test profile, replacing blades and/or structure as specified, until a failure defined in Test Requirements is detected. Analyze the resulting failure data using a Weibull probability plot to estimate the reliability. The estimate shall be R95C50 or better at one life. Deviations to this must have approval by the GM SVE and DE for the program.

Note: A Weibull slope of $\beta = 1.5$ shall be used as a default and for new suppliers or new designs. The value can be increased based on the following:

- a. Experienced Supplier.
- b. Similar Designed Systems with historical data (carryover motor, carryover linkage, etc.)
- c. **AND** approval by the SVE and DE for the program.

Supplier shall notify SVE and DE of the Weibull slope used and whether Success or Failure Test Method will be used prior to start of any testing.