



Horizontally Hinged Power Liftgate System Cycle and Obstacle Durability

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 test is to evaluate power cycling, manual cycling, and obstacle durability of a power liftgate system.

1.2 Applicability. Passenger cars and multi-purpose vehicles with a power liftgate or hatchback system.

1.3 Remarks. This procedure can be performed on full vehicles or partial vehicle bodies, Body in White (BIW).

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- CG190 GM Evaluation Report
- CG583 Development/Validation Test and Vehicle Review
- Power Liftgate Component Technical Specification (CTS)
- Power Liftgate Subsystem Technical Specifications (SSTS)

3 Resources

3.1 Facilities. The facility should have all of the equipment listed in 3.2 and be capable of providing the conditions required in 4.2.

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 Hardware.

3.2.1.1 Obstacle Simulation.

3.2.1.1.1 Actuators. Electric or pneumatic actuators used to simulate inside and outside, upper and lower, and secondary obstacles.

3.2.1.1.2 Spring Loaded Dampeners. Dampeners used to prevent damage by an actuator to the liftgate or liftgate interior trim during inside and outside, upper and lower obstacle simulation. Refer to the Power Liftgate SSTS/CTS to determine the appropriate stiffness for the dampeners.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 1 of 18

Documents

Document Sharing Hub



3.2.1.1.3 Secondary Obstacle Tube. Secondary obstacle tube used to simulate obstacle detection for the secondary obstacle sensor if applicable. Refer to the Power Liftgate SSTs/CTS to determine the appropriate diameter and stiffness for the tube.

3.2.1.2 Test Rig/Fixture. Structural framing to mount the test vehicle, if applicable, as well as any additional hardware to mount the actuators inside and outside of the test body, as required. Test rig/fixture shall be capable of adjusting vehicle inclination to simulate up or down hill grades as stated in the Component Technical Specification, paragraph "Operating Environment Definition". See Figures A1 through A5 for further details.

Note: Setup considerations should be made to design and engineer an interface between actuators and test sample to prevent excessive local damage.

3.2.1.3 Special fixtures or instrumentation may be required to actuate the power liftgate system.

3.2.1.3.1 Touchpad Switch. Wired in way that the contact closure of the switch can be simulated electrically using applicable instrumentation and computer controls to open the liftgate.

3.2.1.3.2 Shutface Switch. Wired in way that the contact closure of the switch can be simulated electrically using applicable instrumentation and computer controls to close the liftgate and set the garage height, if applicable.

3.2.1.3.3 Mode Switch. This device is used to change the opening range of the liftgate to garage height and to change the liftgate to operate in manual mode, if applicable. The mode switch is typically wired in with instrumentation to switch between full-open, garage height, and manually mode more conveniently.

3.2.2 Instrumentation.

3.2.2.1 Load Cells. Load cells used to measure the load exerted by an actuator onto the liftgate or liftgate interior trim during inside and outside, upper and lower obstacles. Refer to the Power Liftgate SSTs/CTS to determine the appropriate range of the load cells.

3.2.2.2 Inclinator. Inclinator used to measure the liftgate angle during cycling.

3.2.2.3 Serial Communication. Applicable device used to send and receive serial communication to and from the Body Control Module (BCM) or Power Liftgate Module.

3.2.2.4 Data Acquisition and Electronic Data Storage. Device or software used to monitor and record signals from the vehicle and instrumentation (see 4.3.2.4) at a minimum scan rate of 1000 samples per second with sufficient memory storage capacity (160 GB minimum).

3.2.2.5 Test Controller. Applicable device, typically an I/O controller, capable of automating the power actuation of the liftgate system as well as any applicable actuators.

3.2.2.6 Power Supply. Power supply capable of providing 9 V to 16 V and 50 A.

3.2.3 General Tools.

3.2.3.1 Torque Wrench. Capacity of approximately 1.5 times each fastener torque referenced.

3.2.3.2 Force Gauge(s). Range of one and a half times the specified requirements, or equivalent, for measuring operating efforts and static latch efforts.

3.2.4 Test Examples. Examples of various test setups are provided in Appendix B.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Property. This can be a full vehicle, partial vehicle, or a Body in White (BIW) with full power liftgate system that includes, but is not limited to full liftgate trim, sill plate, wire harnesses, liftgate primary seal, tail lamps, latch and any trim that interfaces with power liftgate components.

3.3.1.1 Complete rear closure assembly with any necessary option installed, or required by the requesting engineer.

Note: It is required that the body be subjected to the production-intent assembly and paint process to ensure representative strength characteristics. It is recommended that the test parts/assembly be dimensionally certified before testing is started.

The requesting engineer will determine how many closure panels (sample size) will be tested.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 2 of 18



Documents

Document Sharing Hub

3.4 Test Time.

Assumptions: Testing is performed 24 h a day, 7 d a week, that includes allowable soak time (4 h to 12 h minimum depending on power liftgate system) prior to start of each environment. Reference the SSTS for the total number of cycles to be completed per life.

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested. (Submission of the Program SSTS and CTS along with the test request is required.) Any unique test requirements must be listed in the CG583 form.

The following information is required to run this test:

3.5.1 Durability Cycle Requirement.

3.5.1.1 The total number of cycles of the closure panel per life and the number of lives.

3.5.1.2 The total number of closure panel samples required for testing.

3.5.1.3 The durability cycle definition, typically found in the SSTS.

3.5.1.4 Garage Height (where applicable).

3.5.2 Measurements and Checks.

3.5.2.1 Criteria for measurements and checks as well as frequency of when to take them, typically found in the SSTS.

3.5.2.2 Gap and flushness specifications.

3.5.2.3 Fastener torques.

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 shown in 3.4.

4 Procedure

4.1 Preparation.

4.1.1 Prior to start of test, the responsible engineer for the test will provide an approval form (suggested CG583 form which is available in GDM). This form will provide approvals for proper test setup, representative product content, test buck attributes and performance requirements per SSTS.

4.1.2 Requesting Engineer and Design Engineers (DE) shall inspect the test items to ensure all material is at correct design level. Deviations shall be noted on the approval form.

4.1.3 Any deviations from the SSTS/CTS requirements or the requirements of this standard shall have the agreement of the Validation Engineer, Test Engineer, and the Design Engineer(s). Such deviations shall be noted on the approval form and in test certificates, reports, etc.

4.1.4 Typical signatures on the approval form include: Design Engineer(s), Validation Engineer, Test Engineer and other SMT Engineers as required. DE signatures should include both the mechanical and electrical (ECU/software) aspect of the power liftgate system, as well as any other components whose parts are being validated with this test. Testing may not start until all required approvals are complete.

4.2 Conditions.

4.2.1 Environmental Conditions. Testing is typically performed at ambient, hot, humid, and cold conditions. Refer to the Program Specific SSTS/CTS for specific environmental conditions to be used in this test.

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.

4.3 Instructions.

4.3.1 Initial Inspection.

4.3.1.1 Inspect test material for any cracks, paint chips, dents, and tears/abrasion on weatherstrip. Inspect the areas around the latch, striker, bumpers/wedges, counterbalance attachments, hinge attachments, and power liftgate drive unit attachments for metal deformation and cracks. (These areas will be reviewed during testing and post-test for any subsequent damage.) Document any variation/deviation from design intent.

4.3.1.2 Measure the seal margin to ensure that the appropriate spacing is achieved. Adjust the striker and (if necessary) the hinges to achieve a seal margin within specification.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 3 of 18



Documents

Document Sharing Hub

4.3.1.3 Inspect the striker, latch and over-travel bumpers/wedges to ensure that there is adequate flushness between the liftgate and the quarter panel. Adjust the bumpers/wedges following the Master Process Document (MPD) or as directed by DE.

4.3.1.4 Mark all fasteners, body and liftgate ball studs, and adjustable bumpers/wedges so that any loss of torque or change in adjustment can be identified. Make a mark perpendicular to the gap from the body to the panel at several points around the perimeter of the panel. Note the gap and flushness values at these locations. Two to four locations per side should be marked. An example data collection sheet is shown in Table A3.

4.3.1.5 If a pre-production build test property is being used and operator is unable to simultaneously obtain flushness to the quarter panels, proper seal margin and proper gaps to the exterior trim, then the first priority should be given to seal margin. The second priority should be to obtain the proper gap to any panels (for example, fascias) where slam over-travel or liftgate deflection might result in contact. Flushness to quarter panels has the lowest priority.

4.3.1.6 Initial function checks should be performed. Table A1 provides a typical list of these checks. Refer to the SSTS/CTS for the required measurements. Before performing initial function checks, the closure panel should have been left in the closed position for ≥ 24 h in order to ensure proper weatherstrip set.

4.3.2 Test Monitoring.

4.3.2.1 Functional checks should be performed throughout the test. Refer to the SSTS/CTS for the list of checks to perform and the frequency of measurements.

4.3.2.2 When obtaining measurements in hot, cold or humid conditions, the test property shall be allowed to acclimate (4 h minimum) to the temperature before any measurements are taken.

4.3.2.3 If requested, functional check can be made on all electrical items mounted on the liftgate (for example, back-up camera, lights, touch pad). For back-up cameras, the vision angle shall be noted and monitored for change.

4.3.2.4 Signal Monitoring. For the duration of the test the following signals (if applicable) should be monitored every cycle to assist in root causing issues:

- Battery voltage
- Power liftgate system drive unit current (preferred to have instantaneous and average current) and absolute voltage
- Power liftgate system actuator pressure, both the piston and rod sides (hydraulic systems only)
- Power liftgate open angle
- Cinching latch current and absolute voltage
- Latch ratchet switch voltage
- Latch pawl switch voltage
- Latch sector switch voltage
- Hall sensor voltage
- Position sensor voltage
- Mode Switch voltage
- Touchpad switch voltage
- Shutface switch voltage
- Key fob (Remote Function Activation (RFA)) signal voltage
- Secondary Obstacle Detection (SOD) voltage
- Outside (opening) obstacle load
- Inside (closing) obstacle load

4.3.3 Power Liftgate Cycle Definition.

Note: Cycle sequence will vary depending on the liftgate system functionality. Refer to CTS functional matrix for program specific details.

4.3.3.1 Types of Cycles. Power liftgate testing consists of the following types of cycles:

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 4 of 18



Documents

Document Sharing Hub

4.3.3.1.1 Open/Close Cycles. One open/close cycle is defined as follows:

- a. Send RFA (key fob) signal to power open the liftgate.
- b. Send RFA signal to power close the liftgate.

See Figure A6 in Appendix A for a graphical representation of the liftgate angle plotted against time for a typical open/close cycle.

4.3.3.1.2 Touchpad/Shutface Cycle. One touchpad/shutface cycle is defined as follows:

- a. Send touchpad signal to power open the liftgate.
- b. Send shutface switch signal to power close the liftgate.

See Figure A6 in Appendix A for a graphical representation of the liftgate angle plotted against time for a typical touchpad/shutface cycle.

4.3.3.1.3 Garage Height Cycles (where applicable). A garage height cycle is an open/close cycle where the liftgate opens to a programmed height below full-open. The mode switch shall be set in the garage mode position to run garage cycles. The programmed height to use for testing shall be agreed upon between the DE's, the Test Engineer, and the Validation Engineer prior to start of testing. The open height shall be programmed using the method defined in the power liftgate functional matrix in the SSTS/CTS.

Garage height cycles may be conducted as either open/close or touchpad/shutface cycles as defined in 4.3.3.1.1 and 4.3.3.1.2. A typical garage height cycle will appear similar to Figure A6 in Appendix A, but would open to the programmed height below full-open.

Note: Not all power liftgate systems will have garage height capability. Test Engineer/Validation Engineer should confirm power liftgate system functionality before starting test.

4.3.3.1.4 Low Obstacle Cycles. Lower obstacle detection cycles are defined as follows:

- a. Extend outside (opening) lower obstacle actuator.
- b. Send RFA signal to power open the liftgate.
- c. Liftgate reverses to close after contacting the obstacle.
- d. Retract outside (opening) lower obstacle actuator.
- e. Send RFA signal to power open the liftgate to full-open.
- f. Extend inside (closing) lower obstacle actuator.
- g. Send RFA signal to power close the liftgate.
- h. Liftgate reverses after contacting the obstacle.
- i. (Where applicable) Send RFA signal to open the liftgate to full-open. (Note: this step will only be necessary if the power liftgate system functionality reverses partially instead of reversing to full-open on an obstacle. Power liftgate system functionality should be verified before starting test.)
- j. Retract inside (closing) lower obstacle actuator.
- k. Send RFA signal to power close the liftgate.

The sequence defined in (a) through (k) should be counted as one open/close cycle and one low obstacle cycle.

Touchpad/shutface signals may also be used for running low obstacle cycles instead of RFA signals. Inside and outside obstacle fixtures should be positioned to contact the liftgate at the liftgate angles specified in the SSTS/CTS, or at positions agreed upon by the DE, Test Engineer and Validation Engineer prior to the start of testing.

See Figure A7 in Appendix A for a graphical representation of the liftgate angle plotted against time for a typical low obstacle cycle.

4.3.3.1.5 Secondary Obstacle Cycles. Secondary obstacle cycles are defined as follows:

- a. Send RFA signal to power open the liftgate.
- b. Extend secondary obstacle fixture actuator.
- c. Send RFA signal to power close the liftgate.
- d. Liftgate reverses after contacting the secondary obstacle fixture.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 5 of 18



Documents

Document Sharing Hub

- e. (Where applicable) Send RFA signal to open the liftgate to full-open.
(**Note:** This step will only be necessary if the power liftgate system functionality reverses partially instead of reversing to full-open on secondary obstacle activation. Power liftgate system functionality should be verified before starting test.)

- f. Retract secondary obstacle actuator.

- g. Send RFA signal to power close the liftgate.

The sequence defined in (a) through (g) shall be counted as one open/close cycle and one secondary obstacle cycle.

Touchpad/shutface signals may also be used for running secondary obstacle cycles instead of RFA signals. Secondary obstacle fixture should be repositioned after every 200 secondary obstacle cycles to avoid excessive damage to the secondary obstacle sensor.

See Figure A8 in Appendix A for a graphical representation of the liftgate angle plotted against time for a typical secondary obstacle cycle.

4.3.3.1.6 Upper Obstacle Cycles. Upper obstacle cycles are conducted in two steps, outside (opening) upper obstacles and inside (closing) upper obstacles.

Upper obstacle detection cycles are defined as follows:

- a. Extend upper obstacle (opening) actuator.
- b. Send RFA signal to power open the liftgate.
- c. Liftgate reverses to close after contacting the obstacle.
- d. (Where applicable) Send RFA signal to close the liftgate. (Note: this step will only be necessary if the power liftgate system functionality reverses partially instead of reversing to full close on an upper opening obstacle. Power liftgate system functionality should be verified before starting test.)
- e. Retract upper obstacle (opening) actuator.
- f. Send RFA signal to power open the liftgate to full-open position.
- g. Wait for liftgate to reach full-open position.
- h. Extend upper obstacle (closing) actuator.
- i. Send RFA signal to power close the liftgate.
- j. Liftgate reverses to full-open after contacting the obstacle.
- k. (Where applicable) Send RFA signal to open the liftgate to full-open. (Note: this step will only be necessary if the power liftgate system functionality reverses partially instead of reversing to full-open on an obstacle. Power liftgate system functionality should be verified before starting test.)
- l. Retract upper obstacle (closing) actuator.
- m. Send RFA signal to power close the liftgate.
- n. Wait for liftgate to reach close position.

The sequence defined in (a) through (n) should be counted as one open/close cycle and one low obstacle cycle.

See Figures A1 through A5 for photographs of the setup. Upper obstacle fixtures should be positioned to contact the liftgate at the liftgate angles specified in the SSTS/CTS, or at a position agreed upon by the DE, Test Engineer and Validation Engineer prior to the start of testing.

See Figure A9 in Appendix A for a graphical representation of the liftgate angle plotted against time for a typical upper obstacle cycle.

4.3.3.1.7 Manual Cycles. Manual cycling of the power liftgate system is conducted with the power liftgate mode switch in the off (or disable) position. Manual cycles shall be performed at the speeds specified in the SSTS/CTS using an appropriate measurement device.

4.3.3.1.8 Aggressive Customer Input Cycles. Aggressive customer input cycles are cycles where a manual input is applied to the liftgate during power operation. Refer to the SSTS/CTS for specific cycle definition.

4.3.3.2 Liftglass. If applicable, cycles may be required with the liftglass in the open position for the manual slam segment of the durability schedule. Determine if power liftgate is disabled when liftglass is ajar, if so, 4.3.3.2 is not applicable. Refer to CTS function matrix for additional information.

GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 6 of 18



Documents
Document Sharing Hub