



Horizontally Hinged Rear Closures System Slam 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 the slam durability of a vehicle's horizontally hinged rear closure system.

1.2 Applicability. This procedure applies to horizontally hinged rear closures (i.e., decklids, liftgates, liftglass and endgates). This procedure applies to passenger cars with a decklid closure panel system (such as sedans or coupes), and trucks/multi-purpose vehicles with liftgates, liftglass, hatches or endgates. While not specifically mentioned, this procedure can be used for testing of mid-gates and access doors.

1.3 Remarks. This procedure can be performed on full vehicles or test bucks, as noted in 3.3.1. If a full vehicle is not being used, it is recommended that slam loads first be obtained on a full vehicle and then the test buck. If there are any differences between slam loads on these two properties, then the slam speeds for testing on a buck can be adjusted to match the full vehicle slam loads. It is critical that the two properties have similar setups (for example, seal margin, seal load, gaps). Reference Slam Load test procedure GMW16176.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15179 GMW16176

2.3 Additional References.

- CG190 - GM Evaluation Report (ID)
- CG583 - Development/Validation Test and Vehicle Review (ID)
- Subsystem Technical Specifications (SSTS).

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

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 Electric or pneumatic actuators for opening and closing the rear panel. The actuator used for durability should have travel sufficient to move the rear panel from fully closed to a fully open position. However, the

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actuators should not inhibit the motion of the system, such that when a system free rises, the actuator does not slow or accelerate the rising action. Actuators for actuating handles (or similar release mechanisms) may also be needed. In the case of a touch pad release system, a device may be needed to activate the touch pad to release the latch of the closure panel.

3.2.2 Test rig/fixture with structural framing to mount actuators inside and/or outside of the test body as required.

3.2.3 A device to measure linear or angular velocity capable of SSTS required velocities ($\pm 10\%$).

3.2.4 A device to count test cycles.

3.2.5 Torque wrenches with a capacity of approximately 1.5 times each fastener torque referenced.

3.2.6 Force gauge(s), with a range of 1.5 times the specified requirements, or equivalent, for measuring operating efforts.

3.2.7 A device, such as a pneumatic cylinder may be required to:

3.2.7.1 Move the closure panel to the open position.

3.2.7.2 Push the panel off the seal.

3.2.8 A power supply capable of providing 9 V to 16 V for a fixed duration, typically 200 ms to 300 ms.

3.2.9 If the latch has a micro switch which provides information on latch status, then equipment must be provided to monitor the signal. This signal should be used to confirm that the latch has successfully latched/unlatched. If there are special conditions where the switch cannot be monitored, then the test engineer must be notified and a functional check must be performed at an agreed upon interval. Also, not using the micro switch will require that a check must be performed with each cycle to assure that the panel is closed/open.

3.2.10 If there is a back-up camera on the panel, then a monitor must be available to check the function of the camera. Continuous monitoring is not required, but periodic functional checks must be made.

3.2.11 If there is a touch pad on the panel which is not being used to activate the latch, then a monitor must be available to check the function of the touch pad. Continuous monitoring is not required, but periodic functional checks must be made.

3.2.12 Examples of various test setups are provided in Appendix B (Figure B1 thru Figure B4).

3.3 Test Vehicle/Test Piece.

3.3.1 Test property. This can be a full vehicle or a Body in White (BIW). Due to the cost of full vehicles, BIW is typically used.

3.3.2 Rear closure assembly complete with all fasteners, hinges, all appropriate counterbalance hardware, weatherstrip, endgate cables, bumpers, latch(es), lock, strikers, handles, spoiler, appliques (some may contain touch pad, lamps and/or camera), rear wiper system, wiring harness, glass or any necessary option installed, or required by the requesting engineer. It is recommended that the body be subjected to the production-intent assembly and paint process to ensure representative strength characteristics. It is also recommended that the test parts/assembly be dimensionally certified before testing is started. The seal margins, gaps and flushness should fall within tolerances, nominal position is preferred.

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

3.3.3 Interfacing Hardware. The test property should also be built with components from other System Management Team (SMT) groups that interface with the rear closure panels. Typical hardware is: lamps, fascia with energy absorber and support brackets, wheel liners (to support fascia), rear closure interior trim, bedliners, pull cups/straps, and back glass lace trim.

3.4 Test Time.

Calendar time: 45 d

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 requirement sections tested, DTS, part numbers for all subsystem components, along with the test request is recommended and should be included on the CG583 form.) Any unique test requirements or procedural deviation(s) must be listed in the CG583 form.

The following information is required to be provided prior to starting the test:

3.5.1 Durability Cycle Requirement.

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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 sequence, percentage and closing location of cycles and the velocities at which the closure panel will be closed.

3.5.1.3 The sequence and percentage of cycle counts in each environmental condition (hot, cold, humid, ambient).

3.5.1.4 Method for Unlatching the Panel. The requesting engineer must specify if the latch is to be released through the touch pad, by powering the latch directly or key cylinder. For closures with touch pads, it is recommended that the latch be released by the touch pad. This can be accomplished by utilizing a special fixture, see Figures C1 thru C4 in Appendix C. This fixture not only releases the latch, but can be used to open the panel. **This method may require additional electrical harnesses to allow the touch pad to trigger the latch.**

For manual latches a small pneumatic cylinder must be attached to the outer panel to push on a tab attached to the key.

Note: The decklid latch should not be released by the Emergency Trunk Release (ETR) during durability testing.

3.5.2 Effort measurements to be performed, per the Subsystem Technical Specification.

3.5.3 Rear panel operation requirements to be performed, per the Subsystem Technical Specification. Examples: Squeaks, cracks, loosened fasteners.

3.5.4 The frequency at which inspections/functional checks should be performed.

3.5.5 Gap and flushness specifications.

3.5.6 Fastener torques.

3.5.7 Seal margins.

3.5.8 Duty cycle (maximum number of cycles that can be performed per minute to prevent damage to a motor) of powered systems/latches in each environment. The provided duty cycle must not be exceeded. Duty cycle values can be obtained from the powered system/latch supplier.

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. Required: Prior to start of test; the responsible engineer for the test will provide an approval form (suggested CG583 form which is available in Global Document Management (GDM)). This form will provide approvals for proper test setup, representative product content, and test buck attributes.

Typical signatures include: Design Engineer, Validation Engineer, Analytical Engineer, Test Engineer and other SMT Engineers as required, refer to Appendix D for a recommended list of contacts.

4.2 Conditions.

4.2.1 Environmental Conditions. Reference the SSTS paragraph information to specify the Environmental conditions.

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., including the CG583 form.

4.2.2.1 Considerations should be made to design and engineer an interface between actuators and test sample to prevent excessive local damage.

4.3 Instructions.

4.3.1 Requesting engineer, Design Engineering (DE) and Computer Aided Engineering (CAE) shall inspect the test items to ensure all material is at correct design level.

4.3.2 When material is ready to test, inspect for any cracks, paint chips, dents, tears/abrasion on weatherstrip and document any variation/deviation in the assembly. Inspect the area around the latch, striker, bumpers, and hinge attachments for metal deformation and cracks. (These areas will be reviewed during testing and post- test for any subsequent damage.)

4.3.3 Inspect striker, latch and overtravel bumpers to ensure that there is adequate flushness between the rear closure panel and the quarter panel in addition to static tension between the latch and striker. This parameter of

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adjustment affects measurements such as latching efforts, minimum drop height required for latching, and primary release effort.

4.3.4 Measure the seal margin to ensure that the appropriate spacing is achieved. This parameter affects measurements such as latching efforts and overtravel during slams.

4.3.5 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 overtravel might result in contact. Flushness to quarter panels has the lowest priority.

4.3.6 Mark all fasteners and adjustable bumpers 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 locations per side should be marked. An example data collection sheet is shown in Table A3. Hinge to body fastener torque should also be measured and re-measured at the end of test.

4.3.7 Special fixtures must be designed to actuate the latch release mechanism.

4.3.7.1 Touch Pads. If the touch pad is used, then the fixture used to actuate the touch pad should be representative of the human hand with respect to size. A rectangular pad approximately 50 mm x 15 mm with a 2 mm radius on all edges should be used to prevent unrealistic damage. If a full vehicle is not being used, then it will also be necessary to set up controls to receive the signal from the touch pad and then convert that to a signal to the latch.

4.3.7.2 Key Cylinders. Attach a small actuator to the panel and add a tab to the key. Locate the actuator above the key cylinder so that when extended it will push/pull on the tab and rotate the key. An example of the setup can be seen in Figure A7.

4.3.7.3 Exterior Handles. The fixture should be designed so that it represents the human interface. It should not add any unrealistic loads to the handle.

4.3.7.4 Power Release. The wiring harness to the rear closure panel is usually part of the Body Wiring Harness. It shall be part of the durability test of the rear closure. To hold the wiring harness in the correct position, 3 attachment points must be maintained before the harness crosses over to the rear closure. Forward of the 3 attachment points, splice into the wiring harness to control the power release latches and to perform functional checks of other electrical systems (for example, touch pad, back-up cameras, lamps). This way the harness will experience the impact of the panel cycling.

4.3.8 Assemble proper test equipment to the rear panel fixture so the panel can be assisted to the full open position and then slammed shut. Several test setups are depicted in Figures A1 thru A10 in Appendix A.

4.3.9 For opening panels, the test requester should be consulted as to how the fixture should be attached to the test property to fully open the panel.

4.3.9.1 For decklids with free rise systems, no assistance is required. For decklids with pop-and-hang or pop-and-sit counter balance it is necessary to move the panel to the full open position. It is recommended that the panel be pulled from the outside to better represent the customer usage. If there is no exterior handle, then it is preferred that the opening push/pull location be near the hem edge and near the centerline of the panel. The exact method is not critical so long as the method does not put loads into the panel that do not represent customer usage. For example, it would not be a good idea to drill holes in the outer panel for an attachment point. The preferred method is to lift from the touch pad or hem edge.

4.3.9.2 For liftgates, after the latch is released, it is recommended that the panel be pulled from the outside to better represent the customer usage. If there is no exterior handle, then it is preferred that the opening push/pull location be near the hem edge and near the center of the panel. If there is a handle on the gate, then it should be used to pull the liftgate off and fully opened from the hem edge.

4.3.9.3 For endgates, after the latches are released, the gate can be pushed or pulled off the seals. The contact point should be near the center top edge of the panel. Then the test fixture should lower the gate to the angle specified in the SSTs, and then the gate should be allowed to free fall. For dampened gates, the fixture should move out of the way to allow the gate to fully free fall. It is recommended that the gate be pulled open from the outside handle to better represent customer usage.

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4.3.10 For closing panels, the test requester should be consulted as to how the fixture should be attached to the test property to fully close the panel. Whether the panel is pushed or pulled closed, it is critical that the closure fixture be disengaged as the latch approaches the striker.

4.3.10.1 For decklids the panel should be pushed closed along the horizontal surface as far rearward as possible. If there is a spoiler on the decklid, then the test fixture would push on the spoiler.

4.3.10.2 For liftgates the panel should be closed by pushing/pulling from the hem edge.

4.3.10.3 For endgates the panel should be closed by pushing/pulling from the top edge.

4.3.11 For rear closures with gas struts, the panel should be lifted to the point where it will free rise. It is important that the rear closures not be lifted too fast or the strut seals might be damaged. A maximum speed of approximately 0.5 m/s should be used.

For closing a rear closure with gas struts, the closing fixture should be set up to lower the rear closure panel at a maximum speed of 0.5 m/s to an angle just above the free fall point and then accelerate to the specified slam velocity. The closure arm must be in contact with the panel before accelerating to the specified slam speed. The closure arm must stop before the rear panel's latch and striker engage.

4.3.12 Attach a flag to the closure panel to monitor slam speed. Confirm with the test requester where slam speed should be measured (for example, hem edge or at latch/striker). Most requirements specify the speed at the latch. If, due to panel design, it is not possible to place the speed flag in the correct position, then find a location that can be used. Then the operator must measure the distance from the pivot point to the speed flag location and adjust the slam velocities. Lengths must be analytically measured as physical measurements are often difficult to make, especially with multiple link hinges. If the specification is in radians per second, then the operator must first convert the speeds to meters per second by multiplying the speed by the length from the latch to the hinge pivot point (in meters). See Figure B1.

$$Vel_{New} = Vel_{Spec} \times (Radius_{New} / Radius_{Spec})$$

Where:

Vel_{New}	= Adjusted velocity at flag, meters per second
Vel_{Spec}	= Specified slam velocity, meters per second
Radius_{New}	= Swing radius from hinge axis to flag, meters
Radius_{Spec}	= Swing radius from hinge axis to latch up point, meters

For multiple link hinges, CAE must identify the location of the instant center when the panel is nearly closed. This will be used for locating the velocity flag. CAE must also identify the average location of the instant center for locating the pivot point of the closing arm of the slam fixture.

4.3.13 Power Supply. For systems with electric release latches, confirm with Electrical Engineer as to voltage requirements. For vehicles with a typical 12 V system, the power source used to release the latch must be capable of sending a signal from 9 V to 16 V. The Validation Engineer should provide the voltage test schedule. The length of the signal is typically 200 ms; confirmation should be obtained from the requesting engineer.

4.3.14 Perform function checks. Before performing any function checks, the closure panel should have been left in the closed position for at least 24 h in order to ensure proper weatherstrip set (this is only an issue if a new weatherstrip is installed). Refer to the SSTs for the measurements required. (See Table A1.) When obtaining measurements in hot, cold or humid conditions, the test property must be allowed to acclimate to the temperature before any measurements are taken. Most effort checks can be obtained by following GMW15179 – Articulation Efforts.

Note: Hinge to body fastener torque should be measured before and after test in addition to monitoring the fasteners for rotation throughout the test.

4.3.14.1 A 4 h soak is recommended. When moving the test property from one environment to another environment, it must soak at least 4 h before testing is started again. The panel must be in the fully closed and latched position when changing environments and during the environmental soak.

4.3.14.2 Functional check must be made on all electrical items mounted on the decklid (for example, back-up camera, lights, touch pad). For back-up cameras, the vision angle must be noted and monitored for change.

4.4 Cycle Definition.

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4.4.1 The rear closure panel will be unlatched by one of the methods detailed in 4.3.7.

4.4.2 The rear closure panel will be pushed/pulled open and assisted to the autorise point, see 4.3.9.

4.4.3 The rear closure panel will then be pushed/pulled closed to the free-fall angle, see 4.3.10. The panel will then be slammed shut to the speed specified in the SSTs. When setting up the slam fixture, ensure that the fixture can accelerate the panel up to the desired velocity and then let the panel "coast" through the velocity gate to the fully closed and latched position. The fixture must allow the panel's inertia to complete the slam and not be forcing the closure panel all the way into the closed position.

For endgates, the panel will be lifted up to approximately 45 degrees and will then be slammed shut to the speed specified in the SSTs. Adjustments to the lift angle might be required to achieve all the specified slam speeds. Reference Figure B1 thru B4 in Appendix B.

4.4.4 Cycles per minute. For systems with gas struts, the maximum cycle rate is about 2 to 3 cycles per minute. During testing in the hot chamber, this rate should be reduced to about 1.5 to 2 cycles per minute. Limiting the cycle rate prevents overheating of the struts. The requestor should also specify the duty rate for power closures and latches (per 3.5.8). Testing of the closure panels should not exceed the duty cycle or the strut cycle rates suggested in the preceding.

5 Data

Unless otherwise requested in 3.5, the data to be recorded are the observances during the test of any issues called out by the SSTs requirements.

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation.

- Sample Data Collection Sheet – Table A1
- Instrumentation Log – Table A2
- Gap and Flushness Collection Sheet - Table A3

The final test report shall be presented in a format consistent with the CG190 Template.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Definitions for common rear horizontally hinged closure panels are provided here. There are hybrid closure panels that might fit into more than one definition (e.g., 2004 Chevrolet Malibu Maxx).

Decklid: The rear access to storage compartment of a vehicle. The panel swings upward after being unlatched. The decklid does not provide access to the passenger compartment except in the case of fold down passenger seats. The decklid is comprised of a horizontal and a vertical surface.

Endgate: A rear access panel that swings downward after being unlatched; typically used as the rear panel on pickup trucks. Can also be used on passenger cars in conjunction with a liftgate, hatch or liftglass (e.g., 2007 BMW X5).

Hatch: The rear access to the storage compartment of a vehicle. The panel swings upward after being unlatched and guided above the cross over position. Hatches are oriented so that the latch is significantly rearward of the hinges (e.g., 2007 Corvette Coupe). The hatch does provide access to the passenger compartment, but is not used for passenger entry/exit.

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Liftgate: The rear access to the storage compartment of a vehicle. The panel swings upward after being unlatched and guided above the cross over position. Typically, liftgates are vertically oriented. The liftgate does provide access to the passenger compartment, but is not typically used for passenger entry/exit.

Liftglass: A secondary swing panel on a liftgate that swings upward after being unlatched (e.g., 2007 Saab 9-7X SUV). The liftglass has a small or no structural frame.

7.2 Acronyms, Abbreviations, and Symbols.

BIW	Body In White
CAE	Computer Aided Engineering
DE	Design Engineering
ETR	Emergency Trunk Release
GDM	Global Document Management
GSSLT	Global Subsystem Leadership Team
SMT	System Management Team
SSTS	Subsystem Technical Specification
SVE	Subsystem Validation Engineer
VTs	Vehicle Technical Specification

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW16156

9 Release and Revisions

This standard was originated in January 2009. It was first approved by the Front and Rear Closures Global SSLT in June 2009. It was first published in July 2009.

Issue	Publication Date	Description (Organization)
1	JUL 2009	Initial publication.
2	MAR 2012	Added: Section 3.3.3, 3.5.1.4, 4.3.9, 4.3.10, Figures B4, C1-4, and Appendix C. Updated: Sections 3.2.11, 3.3.2, 3.5.2, 3.5.3, 3.5.8, 4.3.7.1, 4.3.7.2, 4.3.7.4, 4.3.8, 4.3.11, 4.3.14, 4.4.1 thru 4.4.4. (Front and Rear Closures GSSLT)
3	MAR 2018	"Hydraulic" removed from 3.2.1. Added "all fasteners", all appropriate hardware to counterbalance, "endgate cables" and "glass" in 3.3.2. Added "support brackets" and "bedliners" in 3.3.3. Added requirements sections tested, DTS and part numbers for all subsystem components and the CG583 reference. Noted that deviations must be noted on CG583 form. Noted that required information needed to be submitted prior to starting the test in 3.5. Added "by powering latch directly", and replaced "hydraulic" with pneumatic" in 3.5.1.4. Added "to" for a grammatical correction and the sentence referencing fixture interaction with a dampened gate in 4.3.9.3. (Body – Front and Rear Closures Global Subsystem Leadership Team (GSSLT))

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