



Articulation Effort Plot - Body Closure Panels Horizontal Hinge Axis

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 procedure measures the force required to operate the body's horizontal hinge axis closure panels (hoods, hatches, decklids, liftgates, liftglass, midgates, endgates, etc..) in both the opening and closing directions.

1.2 Applicability. This procedure applies to any/all vehicles having hood, decklid, hatch, liftglass, tailgate, endgate, midgate or liftgate systems, or any similar closure panel system with a horizontal hinge axis.

1.3 Remarks. This procedure describes a preferred and an alternate method of measuring operating efforts. The alternate method (manual data plotting) is more operator sensitive, but might be used in situations where it is not feasible to conduct the preferred method (electronic data acquisition).

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14830

2.3 Additional References.

Vehicle Technical Specification (VTS)/Subsystem Technical Specification (SSTS):

- 55.02.01 Liftgate and Liftglass
- 55.02.02 Endgate
- 55.02.03 Midgate
- 55.02.05 Decklid
- 55.03.01 Hood SSTS

3 Resources

3.1 Facilities. Test area with a level parking surface.

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.

Note: The following list(s) include fixturing and instrumentation typically used to perform this test. Other equipment may be substituted at the discretion of the testing facility as long as it provides the same data and/or data record, with equivalent accuracy as specified herein or by the requestor.

3.2.1 Fixturing.

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3.2.1.1 Adapter to attach a load cell/force gage to the edge of the closure panel that interfaces with the operator. See Figure A1.

3.2.1.2 T-handle that attaches to the load cell. See Figure A1.

3.2.2 Instrumentation.

3.2.2.1 Preferred Test Method (Electronic Data Acquisition).

3.2.2.1.1 Load cell with operating range of 0 N to 200 N. See Figure A1.

3.2.2.1.2 Angle transducer or inclinometer, with 0 degrees to 120 degrees operating range or Angular rate sensor integrated to calculate angle.

3.2.2.1.3 Data Acquisition equipment.

3.2.2.2 Alternate test method (manual data plot).

3.2.2.2.1 Force Gage, 0 N to 200 N.

3.2.2.2.2 Inclinometer, 0 degrees to 120 degrees.

3.3 Test Vehicle/Test Piece.

3.3.1 This test requires a buck, body or vehicle with the appropriate closure panel system including, hinges, weather-strip, counterbalance mechanism, trim and any other components that would affect the mass or performance of the closure panel.

3.4 Test Time.

Calendar time: 1 d

Test time: 2 h

Coordination time: 1 h

3.5 Test Required Information. The requesting engineer is responsible for providing specifications appropriate to the particular vehicle line being tested. Reference VTS/SSTS numbers, if applicable. See 2.2.

The following specifications or information are required to run this test:

3.5.1 Specific counter balance adjustment position(s) as required.

3.5.2 Desired trim level or weight to compensate for missing trim.

3.5.3 Specific test temperature(s) or vehicle inclinations.

3.6 Personnel/Skills. Prior experience in setting up and running similar tests and experience in the use of the referenced test equipment.

4 Procedure

4.1 Preparation.

4.1.1 Sample Inspection.

4.1.1.1 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.

4.1.1.2 Note on Data Sheet B1 in Appendix B the type of counterbalance system and the adjustment position of the counterbalance system, if applicable (i.e., torque rods in low, nominal or high output position) or the strut pressure if applicable. Also note any options present in the system such as a spoiler.

4.1.1.3 Note on Data Sheet B1 the number of cycles on the system, if known.

4.1.2 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).

4.1.3 Facilities and/or Equipment Preparation.

4.1.3.1 Calibrate the Load Cell as Required. Zero the load cell/force gage with the adapter mounted to the load cell but not attached to the closure panel.

4.1.3.2 Mount the inclinometer or angle rate sensor on the closure panel's surface close to the hinged edge and perpendicular to the hinge axis. Make sure the mounting location will provide adequate clearance to other body

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parts and surfaces throughout the closure panel's design intent range of motion. Zero the angle sensor used when the closure is fully closed. See Figure A2.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified in this document's text or by the requesting engineer, the typical environmental conditions for this test are 22 °C ± 3 °C, relative humidity of 40% ± 20%.

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 Set Up Instructions.

4.3.1.1 Unlatch, but do not open the closure panel, and attach the force gage/load cell at the centerline of the closure panel edge furthest from the hinge pivot, using the adapter. Ensure the adapter design will allow the force gage/load cell's load direction centerline to remain tangent to the closure panel's swing line through its full travel.

4.3.2 Test Operation Instructions.

4.3.2.1 Preferred Method. With all data acquisition equipment ready to record, use the T-handle to move the closure panel through the full range of motion in both the opening and closing directions. Apply the force tangential to the swing of the panel at a rate of 25 mm/s. See Figure A3. When at the closed position, do not attempt to latch the panel as Latch forces are handled by GMW14830 See typical plot on Figure A4.

4.3.2.2 Alternate Method. Using the inclinometer and the force gage, while moving the closure panel through the full range of motion in both the opening and closing directions, record the tangential force in 5 degree increments. Data points should be taken while continuously moving the force gage at approximately 25 mm/s. See typical plot on Figure A5.

4.3.2.3 Handle Force Measurement. If handles exist on the exterior of the vehicle closure panel, additional testing should be made from the handle when opening the panel following the method described in 4.3.

If handles exist on the interior of the vehicle closure panel, additional testing should be made from the handle when closing the panel following the method described in 4.3.

5 Data

The collected load and angle data shall be plotted on an X-Y plot. Angle is the X axis data and the load is the Y axis data.

5.1 Calculations. If using an angular rate sensor, the angular rate needs to be integrated to determine angle.

If force requirements are specified at locations other than the hem, adjust the measured values using the following.

$$F_{\text{desired}} = F_{\text{measured}} * R_{\text{measured}}/R_{\text{desired}}$$

5.2 Interpretation of Results.

Note: The Y scale on the graph in Figure A4 has different signs (±) for the opening and closing curves. Above the zero force line is a positive closing effort and a negative opening effort. Below the zero force line is a positive opening effort and a negative closing effort. See 5.2.1 through 5.2.4.

5.2.1 A positive closing effort is any effort above the zero force line and represents a closure panel that requires an external input force to close.

5.2.2 A negative closing effort is any effort below the zero force line and represents a free falling closure panel.

5.2.3 A positive opening effort is any effort below the zero force line and represents a closure panel that requires an external input force to open.

5.2.4 A negative opening effort is any effort above the zero force line and represents a free rising closure panel.

5.2.5 The difference in force between the opening and closing curves (measured vertically) represents friction in the system.

5.2.6 The static equilibrium region refers to an area in the panel's travel where, if the panel is released, it will neither free rise nor free fall but will remain at that position. It is an area on the graph where the closing curve is

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