



Door Check Link Function

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. To evaluate the function of the door check link in terms of forces required to operate the door, the ability to hold the door open on grade, and door rebound/bounce-back behavior.

1.2 Applicability. For all vehicles having vertically hinged doors.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15886 (ID)

(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.

2.3 Additional References.

- SSTS 55.01 Side Doors paragraph 3.2.1.1.1 Door Hold Open on Grade, 3.2.1.6.1 Efforts – Door Operating, and 3.2.2.1.3 Door Hold-Open Positions.

3 Resources

3.1 Facilities. Test area with level 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.

3.2.1 Force gage with the ability to measure compression and tension. (Load cells with the associated equipment may also be used).

Associated pull hook or protective tip may be required for the force gage.

3.2.2 Inclinometer.

3.2.3 Linear measuring device (tape measure).

3.2.4 Linear velocity meter (Debron Industrial Electronics, Inc. Optical Door Velocity Meter Model number 1052 or number 1053 or equivalent) or rotational velocity meter (NeuwGhent Technology Angular Rate Sensor SAG-11250M4 or equivalent).

3.2.5 Method to raise the vehicle to the desired grade (surface incline, jacking mechanism, etc.)

3.2.6 Protractor.

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3.3 Test Vehicle/Test Piece. Fully equipped door mounted on vehicle. Development testing may be done on fixtures or side rings as required. If full vehicles are not used the test fixturing must simulate the vehicle pillar position and the mounting of the hinges and checks links.

3.4 Test Time.

Calendar time: 1 d
Test time: 2 h to 4 h
Coordination time: 1 h to 2 h

3.5 Test Required Information. Mass Moment of Inertia (MMI). Provided by requesting engineer. See procedure GMW15886.

3.6 Personnel/Skills. Familiarization with test equipment required for this test procedure.

4 Procedure

4.1 Preparation. The closure to be tested shall be evaluated in order to ensure that all material/door components are present and correctly assembled. This test is normally run in the **as received** condition on level ground.

4.1.1 Facilities and/or Equipment Preparation. Record the instrumentation calibration information on Data Sheet A1 or an equivalent document.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified by the requesting engineer, the test shall be performed at an ambient temperature of $22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

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 Setup Instructions. Cycle the closure system through at least five (5) full cycles from fully closed to full open. As applicable, note any irregular sounds or erratic operation indicating a potential problem with the check link.

4.3.2 Functional Testing.

4.3.2.1 Detent Forces – Opening. Ensure vehicle is on level ground.

4.3.2.1.1 Zero the force gage.

4.3.2.1.2 Unlatch the door.

4.3.2.1.3 Using the force gage and the appropriate attachment pull at the center of the outside handle (Figure 1). The center of the handle for this test is the center of the grip or finger access point for handle actuation. Pull so that the direction of force remains normal to the door outer panel at the load application point. The pull shall be with a smooth and consistent speed. Record the peak forces encountered in the following segments of the door swing as appropriate (Figure 2) on Data Sheet A2.

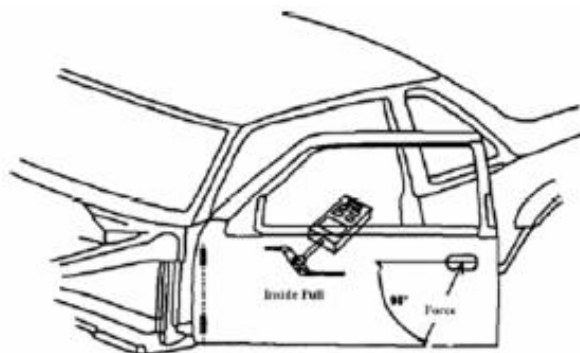


Figure 1: Force Application on Inside and Outside Handles

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- Ajar to 1st detent position.
- 1st detent position to intermediate detent position.
- Intermediate detent position to full open detent position.

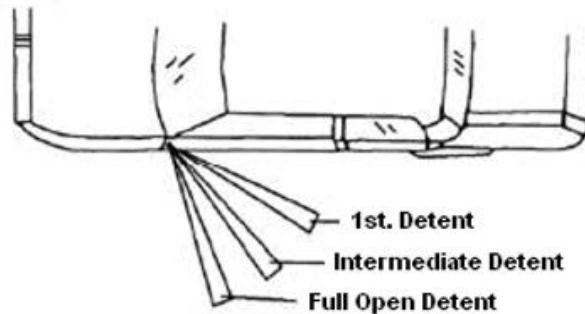


Figure 2: Detent Locations

4.3.2.1.4 Repeat the opening forces using the force gage, but this time pushing at the center of the inside pull handle. (Figure 1)

4.3.2.2 Detent Forces – Closing. Ensure vehicle is on level ground.

4.3.2.2.1 Zero the force gage.

4.3.2.2.2 Open the door to full open.

4.3.2.2.3 Using the force gage and the appropriate attachment, push at the center of the outside handle (Figure 1). The center of the handle for this test is the center of the grip or finger access point for handle actuation. Push so that the direction of force remains normal to the door outer panel at the load application point. The push shall be with a smooth and consistent speed. Record the peak forces encountered in the following segments of the door swing as appropriate (Figure 2) on Data Sheet A3.

- Full open detent position to intermediate detent position.
- Intermediate detent position to 1st detent position.
- 1st detent position to ajar.

4.3.2.2.4 Repeat the closing forces using the force gage, pulling at the center of the inside pull handle (Figure 1).

4.3.2.3 Rebound/Bounce-back Behavior. Ensure vehicle is on level ground.

4.3.2.3.1 Position the door to the ajar position.

4.3.2.3.2 Attach velocity meter interrupter near rear hem of the door, and attach velocity to the ground at a position such that the velocity at the rear edge of door can be captured/measured as the door passes through the valley of the 1st detent in the door opening direction (Figure 3 and Figure 4). Reference Side Closures SSTS paragraph 3.2.1.6.1.b for requirements.

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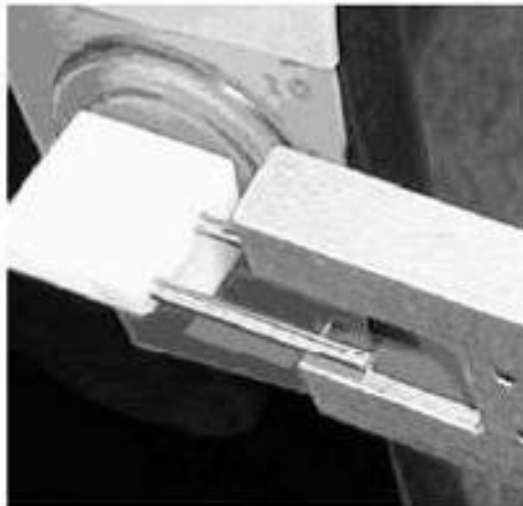


Figure 3: Interrupter Aligned with Sensor

4.3.2.3.3 How to determine the test velocity (i.e., opening velocity) of the door to be tested:

The following information should be provided:

- 1) I = Rotational MMI: Units $[\text{kg} \cdot \text{m}^2]$; Obtained by performing GMW15886.
- 2) E = Door Opening Energy: Units $[\text{J}]$ or $[\text{kg} \cdot \text{m}^2/\text{s}^2]$; From SSTs 3.2.1.6.1.b.

Standard formula for calculating Linear Velocity on a rotating object:

$$V_L \left[\frac{\text{m}}{\text{s}} \right] = \omega \left[\frac{\text{rad}}{\text{s}} \right] * R[\text{m}]$$

Where:

V_L = Linear velocity in meters per second.

ω = Rotational velocity in radians per second.

R = Distance between hinge centerline and velocity meter interrupter in meters (measured on test property).

Using the standard equation for Rotational Energy: $E = \frac{1}{2} * I * \omega^2$, we can solve for ω .

$$\omega \left[\frac{\text{rad}}{\text{s}} \right] = \sqrt{\frac{2 * E \left[\frac{\text{kgm}^2}{\text{s}^2} \right]}{I[\text{kgm}^2]}}$$

Substituting " ω " into our initial equation yields the final equation for solving for linear velocity:

$$V_L \left[\frac{\text{m}}{\text{s}} \right] = \sqrt{\frac{2 * E \left[\frac{\text{kgm}^2}{\text{s}^2} \right]}{I[\text{kgm}^2]}} * R[\text{m}]$$

4.3.2.3.4 Testing Method. Manually swing the door open such that it freely moves through the valley of the first detent (i.e., the test engineer swings the door to get it moving at the desired velocity but releases the door prior to the velocity being measured) at the speed equal to the linear velocity found earlier in 4.3.2.3.3, and note where the door comes to a stop.

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