



## Test Procedure for Vertically Hinged Door Closing Energy/Velocity

### 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 provide a common procedure for determining the minimum door closing energy and/or velocity to fully latch a door system. To provide a common method for determining the dynamic energy of a moving door at any point in the door travel.

**1.2 Applicability.** This procedure applies to all swing doors having a vertically hinged system.

**1.3 Remarks.**

**1.3.1** Minimum closing energy is a required part of the Subsystem Technical Specification (SSTS).

**1.3.2** This test is performed to determine if a specific door's minimum closing energy is within the specified range.

**1.3.3** This test may be used to determine dynamic energy gained or lost from gravity, friction, check link detents, etc.

**1.3.4** Closing velocity is related to closing energy by the equation:  $E = \frac{1}{2} \times I \times \omega^2$  (See Section 5).

### 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.**

- CG2908 Global Velocity Worksheet
- CG2922 Pre-Test Checklist for Test Ready Properties
- Global Document Management System (GDM)
- Side Doors SSTS, Door Operating Efforts

### 3 Resources

**3.1 Facilities.** Test Area: Level vehicle 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.**

**3.2.1 Hardware.**

**3.2.1.1** Linear velocity meter (Testron Velocity Meter Model MAA37245S, Debron Industrial Electronics, Inc. Optical Door Velocity Meter Model No. 1052 or No. 1053 or equivalent) or rotational velocity meter.

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**Note:** While the Testron velocity meter is GM's standard device for measuring door closing velocity at the 50 mm door open position, some regions (e.g., GMK) and plants still use the Debron velocity meter. It captures the door velocity at the 102 mm open position. This may pose a difference in results vs. the Testron meter simply because one measures at 50 mm open position and the other at 102 mm. Door kick-up, as an example, can have an impact. The Testron has been "the standard" since 2010.

**3.2.1.2 Linear measuring device (tape measure).**

**3.3 Test Vehicle/Test Piece.** A complete vehicle. See Pre-Test Checklist for Test Ready Properties in GDM under document number CG2922.

**3.4 Test Time.**

Calendar time: 1 d to 4 d

Test hours: 1 h to 2 h

**3.5 Test Required Information.** Not applicable.

**3.6 Personnel/Skills.** One technician or engineer with training in performing door closing energy and velocity measures.

## 4 Procedure

### 4.1 Preparation.

#### 4.1.1 Vehicle Setup.

**4.1.1.1 Test Door.** Ensure that the door components are present and properly assembled. Check with the requesting engineer to ensure seal condition required (i.e., green seals, aged seals, etc.) See Glossary in Section 7.1 for definitions of seal aging.

**4.1.1.2** Allow the vehicle to acclimate to the environmental conditions in test area for an appropriate time to allow the vehicle systems to reach test room temperature before the test.

**4.1.1.3** Close windows, moveable roofs, trunk, hatch, mid-gate and any other closure. Close the rear seat pass-through and return all rear seat backs to the upright and latched position.

**4.1.1.4** Power vehicle and place HVAC in Recirculation mode. After HVAC has achieved desired mode turn the vehicle off.

#### 4.1.2 Position of Velocity Meter for Standard Testing.

- During a slam event, the Testron velocity meter senses the rear edge of the door at 2 positions (A and B) as the door passes by these two positions. Velocity is calculated based on the time it takes for the door to move between A and B. The 50 mm position is in the middle between positions A and B. See Figure 1.
- For the Debron meter, suction cup mounts to DIW and has two pins that pass through the velocity gate sensor. Door is at 109 mm open when 1<sup>st</sup> pin passes thru sensor and 95 mm when 2<sup>nd</sup> pin passes thru sensor. Average position is 102 mm as compared to Testron's 50 mm. See Figure 1.
- Use of angular rate sensors or other velocity measures may be used as long as the speed data is gathered within 5 mm of the specified velocity meter.

**4.1.3 Position of Velocity Meter for Additional Testing.** Position the door in the desired location of interest (i.e., 1<sup>st</sup> detent). Common locations of interest:

- Valley of the check link detent: Position of the door at rest when opened to one of the check link detent positions.
- Crest of the check link detent: Position of the door closest to the valley of the detent such that the door doesn't swing open into the valley.

Locate the velocity meter such that the sensors are centered at the desired door location of interest.

Use of angular rate sensors or other velocity meters may be used as long as the speed data is gathered at desired location.

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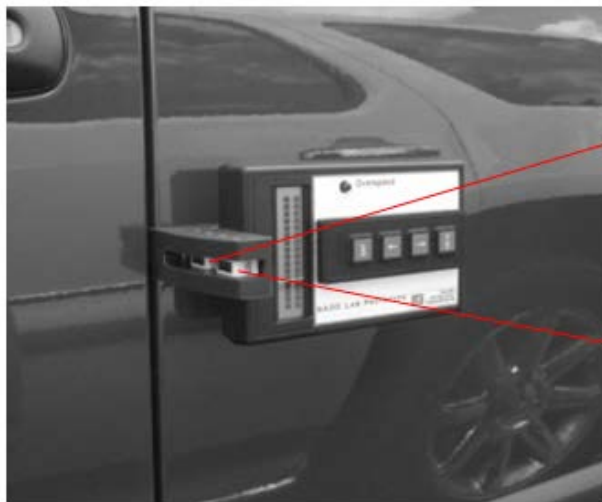
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**B:** 35 mm open position.

**A:** Door is in 65 mm open position when it passes position A.

**Note:** Testron shown at front door striker location.



Suction cup mounts to DIW and has two pins that pass through the velocity gate sensor. Door is at 109 mm open when 1<sup>st</sup> pin passes thru sensor and 95 mm when 2<sup>nd</sup> pin passes thru sensor. Average position is 102 mm – compared to Testron's 50 mm.

**Note:** Debron shown on rear door.

**Figure 1: Velocity Meter Positioning**

## 4.2 Conditions.

**4.2.1 Environmental Conditions.** If not otherwise specified, the measurements 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 Minimum Closing Speed.** Close the door with successively higher or lower velocity such that the difference between the maximum speed the door will not close and the minimum speed the door will close is less than 0.02 m/s or 1 degree/s. The force to rotate the door must be removed prior to the door entering the velocity sensor. Refer to the meters user manual for proper usage.

Record the minimum speed that the door fully closed at the desired location.

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