



## **Measurement of Dynamic Movements - Hood, Liftgate and Trunk Lid**

### **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 standard is the measurement of the critical clearances between hood, tailgate or trunk lid and body components with regard to torsion and bending during actual or simulated driving operation.

**1.2 Applicability.** This standard applies to any development and series production vehicles and all vehicles having the referenced closures with a horizontal hinge axis.

**1.3 Remarks.** This standard can be adapted to be used with any horizontally hinged closure (see CG974 Hood and Fender Subsystem Technical Specification (SSTS), CG972 Endgate SSTS, or CG1729 Midgate SSTS). It is the responsibility of the test/development engineer to revise the data sheets in Appendix A and Appendix B and make the determination of the correct measurement points.

### **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.**

- CG972 Endgate SSTS
- CG973 Decklid SSTS
- CG974 Hood and Fender SSTS
- CG1073 Liftgate and Liftglass SSTS
- CG1729 Midgate SSTS
- Drawing
- Inspection Data

### **3 Resources**

#### **3.1 Facilities.**

**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.

**3.1.3** General Motors Proving Grounds (Dudenhofen, Cruz Alta, Milford, etc.,) test center or equivalent proving ground:

**3.1.3.1** Durability test track.

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**3.1.3.2** Belgian block wave road and potholes.

**3.1.3.3** Washboard track.

**3.1.4** Drive-on four (4)-piston/post Hydro-Pulse System (HPS) (e.g., Schenk HPS) or multiaxial full vehicle simulator.

### **3.2 Equipment.**

**3.2.1** Required for evaluation:

**3.2.1.1** Multi-channel data-recording device, sampling rate 1600 Hz  $\pm$  200 Hz.

**3.2.1.2** In general, the data shall be recorded and evaluated using **Diadem**.

**3.2.1.3** High-pass filter, e.g., Butterworth, 7<sup>th</sup> order, 5 Hz threshold frequency for determination of values using accelerometers.

### **3.2.2 Required for Measurement on the Vehicle.**

**3.2.2.1** Triaxial accelerometer, amplitude measurement error 3% ( $> 5$  Hz), measurement range 100 g, measurement frequency (2 Hz to 2000 Hz).

**3.2.2.2** Type M5L/10 laser distance sensors, measurement range  $\pm 5$  mm ( $\pm 10$  V), sampling frequency 40 kHz, linearity error 30  $\mu$ m, resolution (noise) 3  $\mu$ m.

**3.2.2.3** Laser distance sensors, measurement range  $\pm 10$  mm, useful frequency  $< 100$  Hz, sampling rate  $> 1000$  Hz (see 4.1).

### **3.3 Test Vehicle/Test Piece.**

**3.3.1** Vehicle which represents the state of development. The hood/tailgate/trunk lid shall be adjusted according to Drawing or according to Inspection Data. Optional configuration: The adjustable bumpers/buffer should be set to minimal interference by design/tolerance.

### **3.4 Test Time.**

Calendar time: 3 to 5 days

Test hours: 6 to 8 hours

Coordination hours: 10 hours

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

**3.6 Personnel/Skills.** Prior experience in setting up and running similar tests and experience in the use of the referenced test equipment. One development engineer and one measurement engineer.

## **4 Procedure**

**4.1 Preparation.** The vehicle shall be driven with curb weight (driver, passenger and measuring equipment).

**4.1.1** It shall be ensured that the tire pressures correspond to permissible values.

**4.1.2** The gaps at the positions to be tested shall be measured and documented before and after the tests on Appendix A, Data Sheet A1.

**4.1.3** Before testing, the vehicle shall be fitted with the accelerometers or the laser distance sensors or any other relevant measuring instruments.

**4.1.4** The sensors shall be calibrated before testing and the data recorded.

**4.1.5** For measurement with laser sensors, all track types shall be driven during the preliminary test (see Table 1). On the basis of the measurement results, it shall be determined whether the M5L/10 laser sensor measurement range for the respective axes (x, y, z) is adequate for the maximum occurring closure movement.

**4.1.6** Preferably, laser sensors with the smallest possible measurement range shall be used, as these provide more accurate measurement results. The maximum value of the sensor shall not appreciably exceed the absolute value of the actual movement.

### **4.2 Conditions.**

**4.2.1 Environmental Conditions.** If not otherwise specified, the test shall be performed at  $+23$  °C  $\pm 5$  °C and  $50\% \pm 10\%$  relative humidity. If tested at other environmental condition, record deviation on data sheet.

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**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** Obligatory measuring spots on the tailgate of the wagon are the Positions (Pos.) 1, 2 and 3 (see Figure 1). The development engineer shall decide on the necessity for further measurements at the remaining positions.

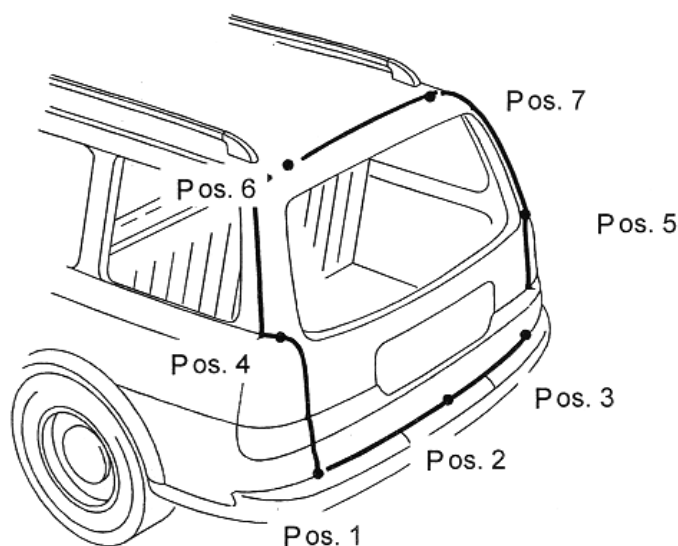


**Figure 1: Measuring Point on Tailgate of Wagon**

**4.3.2** Obligatory measuring spots on the tailgate of the Hatch Back (HB) are the positions 1, 2, 3, 4 and 5 (see Figure 2). The development engineer shall decide on the necessity for further measurements at the remaining positions.

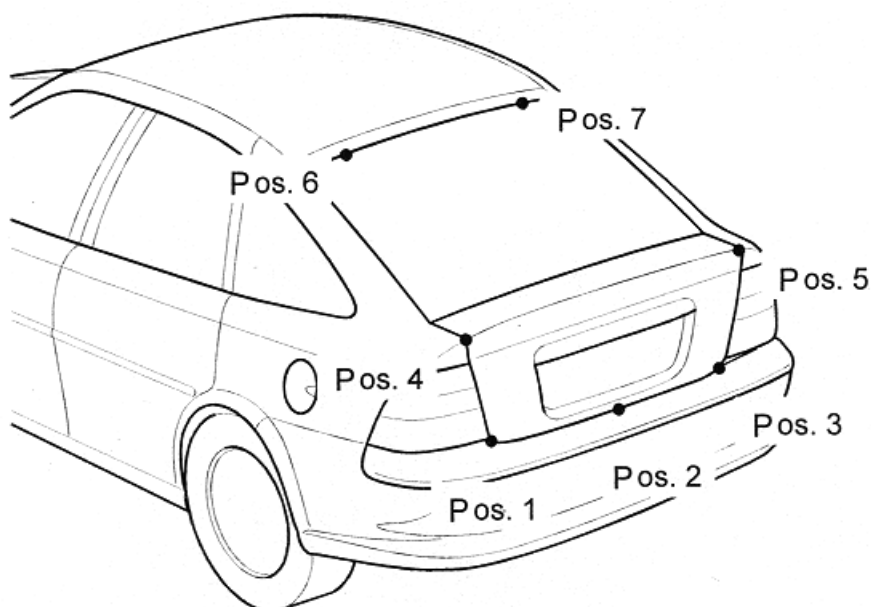


**Figure 2: Measuring Spots on Tailgate of HB**

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**4.3.3** Obligatory measuring spots on the trunk lid of the Notch Back (NB) are the positions 1 to 7 (see Figure 3). For measuring spots on all hoods see Figure 4. The development engineer shall decide on the necessity for further measurements at the remaining positions.

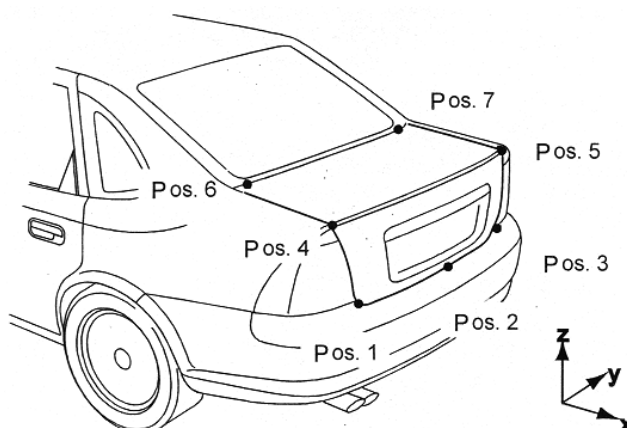


**Figure 3: Measuring Spots on Trunk Lid of NB**

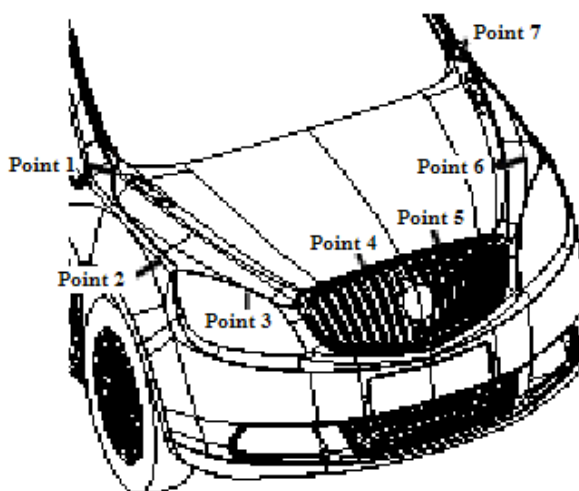


**Figure 4: Measuring Spots on All Hoods**

**4.3.4 Road Test.** For the performance of the test, three test tracks with different test profiles shall be driven, with application of the appropriate driving style (see Table 1 and Figure 5).

In order to prevent coincidental measurement errors, each test track shall be driven three times.

**Table 1: Test Tracks and Driving Style**

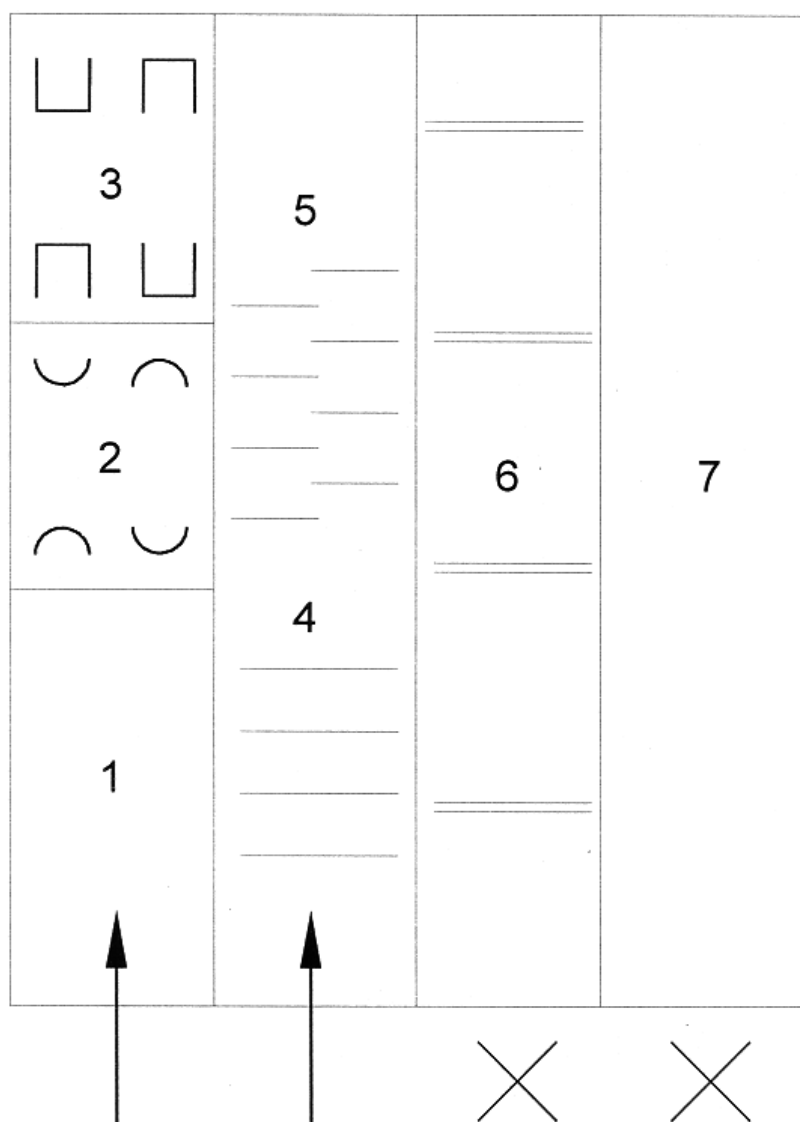
| Number | Test Track                                          | Driving Style                     | Gear                 |
|--------|-----------------------------------------------------|-----------------------------------|----------------------|
| 1      | Durability test track, right lane                   | Constant speed driving at 50 km/h | 3 <sup>rd</sup> Gear |
| 2      | Torture track; Belgian block wave road and potholes | Constant speed driving at 35 km/h | 2 <sup>nd</sup> Gear |
| 3      | Torture track; Washboard track                      | Constant speed driving at 35 km/h | 2 <sup>nd</sup> Gear |

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**Key:**

- 1 = Belgian block wave road
- 2 = Asphalt pothole left/right
- 3 = Concrete pothole left/right
- 4 = Washboard symmetrical
- 5 = Washboard opposed
- 6 = Concrete with transversal joints
- 7 = Rheinstraße

After the test, the gaps shall be measured and documented.

**Figure 5: Torture Track**

**4.3.5 Test on Road Simulator System.** For the purpose of A/B comparison during component development, e.g., hinges, bumpers/buffers, locks or seals, the test may be performed on a road simulator system such as the hydropulse system.

**4.3.5.1** Types of load for bending and torsion shall be measured.

**4.3.5.2** The sampling rate is 1600 Hz.

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