



## **Clutch Assembly Judder Test**

### **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 standard describes the method for testing clutch system for manual transmission with dry running clutch systems. Focus is on clutch judder.

**1.2 Applicability.** For all Front Wheel Drive (FWD), All Wheel Drive (AWD) and Rear Wheel Drive (RWD) manual transmissions with dry friction clutch systems.

### **2 References**

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

#### **2.1 External Standards/Specifications.**

None

#### **2.2 GM Standards/Specifications.**

GMW14264                      GMW15628

#### **2.3 Additional References.**

- Vehicle Technical Specifications (VTS)
- Subsystem Technical Specifications (SSTS)
- Drawings/ Component Technical Specifications (CTS)
- Analysis Development Validation (ADV) Plan
- Statement of Requirements (SOR)
- Application Engineer, Design Release Engineer (DRE)

### **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 Test Track.** A safeguarded road with a constant grade for a complete vehicle launch with grades of 0%, 8% and 12%.

#### **3.2 Equipment.**

**3.2.1** Data recording device for the following measurements:

##### **3.2.1.1 Mandatory Sensors.**

- Ambient temperature (if not covered otherwise)
- Gear box oil temperature
- Air temperature in the clutch housing near upper circumference of clutch pressure plate

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- Air temperature in the clutch housing at the Concentric Slave Cylinder (CSC)/release bearing
- Clutch pedal travel sensor or bus- signal
- Speed of gearbox input shaft (to detect clutch judder vs powertrain shudder)
- Engine speed on bus or sensor at flywheel

**3.2.1.2 Optional Sensors.** Optional instrumentation is to be determined by the responsible Test Engineer.

- Accelerator pedal position (bus)
- Engine torque (bus)
- Air Conditioner (AC) signal at bus
- Vehicle speed
- Acceleration sensor on seat rail (longitudinal or three axial)

**3.2.2** Attached tachometer and speedometer.

**3.2.3** Measurement equipment to measure the clutch pedal characteristic according to GMW15628.

### 3.3 Test Vehicle/Test Piece.

**3.3.1** The engine type and the vehicle equipment must correspond to the release. Engine calibration milestone level for test execution should be  $\geq 65\%$ . The test shall be performed with several vehicles for each test program if possible.

**3.3.2** Hydraulic clutch actuation components according to representative development phase. Clutch components should be used according to specification. The test shall be performed twice, each with a new clutch system (flywheel; clutch cover, clutch disc). Both clutch systems should be measured as clutch system, clutch set and single parts. Transmission assembled according to specification.

### 3.4 Test Time.

Calendar time: 5 days

Test time: 24 h

Coordination time: 8 h

### 3.5 Test Required Information. Possible sources are:

- Vehicle Technical Specifications (VTS)
- Subsystem Technical Specifications (SSTS)
- Drawings/ Component Technical Specifications (CTS)
- Analysis Development Validation (ADV) Plan
- Statement of Requirements (SOR)
- Application Engineer, Design Release Engineer (DRE)

### 3.6 Personnel/Skills.

**3.6.1** Trained and skilled test driver to run test. The person has to fulfill the following criteria:

- Very experienced in driving vehicles with a manual transmission
- Able to sensitively modulate the clutch pedal, gas pedal and parking brake (manual and electric) at the same time
- Has already demonstrated the ability to launch a vehicle with  $\frac{2}{3}$  Gross Vehicle Weight (GVW) load at hill grades

**3.6.2** Experienced Test Engineer to evaluate results.

**3.6.3** Skilled mechanic to mount and dismount test parts according valid process requirements, e.g., counter force free installation. The mechanic shall be skilled in clutch and Dual Mass Flywheel (DMF)/Single Mass Flywheel (SMF) system technology.

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## 4 Procedure

### 4.1 Preparation.

4.1.1 Mounting of the clutch system according to procedure.

4.1.2 Check of the clutch pedal characteristic according to GMW15628. Readjust and/or bleed hydraulic clutch system if necessary.

4.1.3 Fill the car with fuel, check engine oil and coolant levels and tire pressure. Adjust if necessary.

4.1.4 Check the installed measuring and data recording devices.

4.1.5 Preparation of data sheet (see Figure A1 in Appendix A) and end of test sheet (see Figure B1 in Appendix B).

### 4.2 Conditions.

4.2.1 **Environmental Conditions.** The judder test shall be performed on a test track with appropriate inclination, plane (0%, 8% and 12% grade). The length of the track should be sufficient to perform a complete launch at the given gradient. Road conditions must prevent wheels from slipping.

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.

4.2.2.1 AC shall be switched off during test, if there is a no different target within the VTS.

### 4.3 Instructions.

4.3.1 **General Instructions.** Measuring/recording of the data mentioned in paragraph 3.2 during the entire duration of the test. Additionally, the temperatures shall be noted in the data sheet at the times mentioned at paragraph 4.3.4. The clutch disengagement reserve shall be measured and noted in the datasheet at the times mentioned at paragraph 4.3.4. The test shall be performed first with vehicle curb weight plus driver weight and subsequently after a cooling period with  $\frac{2}{3}$  vehicle payload plus driver weight. For details see paragraph 4.3.4.

**Description of a launch process:** Launch the vehicle at the specified gradient uphill by slowly and very carefully engaging the clutch resulting in a low acceleration (it is acceptable, if the vehicle is temporarily moving backwards during the maneuver). While doing that control the position of the clutch pedal to maintain the engine speed constant. Launch speed should be selected depending on the vehicle, vehicle payload and engine performance:

- For launches with curb weight the engine speed should be between idle speed and 1500 Revolutions per Minute (RPM).
- For launches with  $\frac{2}{3}$  vehicle payload engine speed should be between idle speed and 2000 RPM.

Write down the subjective judder evaluation according to GMW14264 into the datasheet and additionally the data log time (see Figure A1 in Appendix A).

4.3.2 **Cold Judder Test.** Before the beginning of cold judder test the vehicle shall have been parked close to the test track for a duration of 12 h minimum. During this period the vehicle shall not be used at all. The temperature shall be (0 to +25) °C. To evaluate and measure the first launch forward and reverse with cold conditioned clutch disc is necessary.

Three launches (as described in paragraph 4.3.1) shall be performed with the cold vehicle respectively at 0% and 12% uphill gradient and in each driving direction (forward and reverse). For details see paragraph 4.3.4.

4.3.3 **Warm Judder Test.** Before the beginning of the warm judder test the vehicle must perform a warm-up period to obtain a gearbox oil temperature of (+70 to +90) °C. Recommended to drive on a high-speed track.

With the warm vehicle three launches (as described in paragraph 4.3.1) shall be performed respectively at 0%, 8% and 12% uphill gradient and in each driving direction (forward and reverse). For details see paragraph 4.3.4.

### 4.3.4 Overview of Test Maneuvers.

1. Preparation of the car with curb weight.
2. Condition the vehicle for cold judder test (according to paragraph 4.3.2).
3. Perform measurement of ambient, gearbox oil and clutch housing air temperature as well as clutch disengagement reserve and note results on datasheet:
  - 3x cold launches forward at 0% gradient
  - 3x cold launches reverse at 0% gradient

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