



Clutch Spin Down on FWD/RWD Transmissions, Deceleration Curve of Clutch Disk Speed

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. Determination of clutch spin down on front wheel drive (FWD) / rear wheel drive (RWD) transmissions and reduction of frictional losses and improvement of gear shifting capabilities.

1.2 Applicability. This Test Procedure is applicable for FWD, RWD manual transmission, automated manual transmission (MTA) and dry double clutch transmission (DCT). It gives a hint of the inner torque losses and it will be performed instead of drag torque measurement at input shaft. This measurement is for getting information of the shift ability of gears and for calculation issues.

1.3 Remarks. The transmission losses depend on various parameters such as rotational speed, load, bearing losses, oil type, lubrication system, temperature and structure. It is hence a requirement for aimed improvements that respective loss contributions are known. In this test procedure, the deceleration of transmission input shaft inclusive clutch disk when disengaged will be measured, after disengaging of a gear, starting from adjusted speed conditions by keeping output speed constant (like constant moving car). The deceleration of input shaft is a hint for inner transmission friction.

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.

- In-vehicle transmission installed angle
- Test request identifying operating temperature (typically +80 °C) and a minimum of two spin down speeds (typically 3000 revolution per minute (rpm) and 6000 rpm)
- Transmission oil fill quantity and oil type

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 The test stand needs a gearbox flange in assembly position, an electric engine output side and a manual gear shift control.

A fan is required for cooling (e.g. Co. Elektror, type D092FUK-50/7.5, 400 V / 95 m³/minute).

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See assembly test stand set-up in attachment (see Appendix A).

3.2 Equipment. (See Appendix A).

3.2.1 Two (2) speed sensors with an accuracy $\leq 0.03\%$ at 3000 min^{-1} (rpm) (e.g. 1x integrated in HBM T10F (or better one, e.g. T12) and 1x HEIDENHAIN ROD 430).

3.2.2 Amplifier with an accuracy $\leq 0.005\%$ (e.g. HBM ML60B). In case an analog signal transmission is used. No amplifier is used, if the signal transmission via CAN-Bus is used (preferred version).

3.2.3 Digital measurement system (e.g. IMC Cronos PL, data acquisition system).

3.2.4 Oil temperature sensor (e.g. NiCrNi) with an accuracy of $\pm 2.5\text{ }^{\circ}\text{C}$ including measurement system.

3.3 Test Vehicle/Test Piece. Complete FWD or RWD transmission without clutch system, only clutch disk with maximum inertia of application.

3.4 Test Time.

Calendar time: 3 days
including run-in (see paragraph 4.1.1)

Test time: 2 h

Coordination time: 2 h

3.5 Test Required Information. Oil fill quantity and oil type.

3.6 Personnel/Skills.

3.6.1 Test Bench Operator. Knowledge is required about test bench control and sensors.

3.6.2 Development Engineer. Knowledge is required about measurement equipment and accuracy.

4 Procedure

4.1 Preparation.

4.1.1 Gather all information required to perform the test (see 3.5).

4.1.2 Create a test protocol (see Appendix B). The test protocol defines, which operating points shall be measured. It is also used to write down the measured values.

4.1.3 The test transmission shall be installed on the test stand in its vehicle assembly position and filled with the oil type and volume specified in the transmission specification. If desired in the assignment, mount the appropriate clutch disk according production intent and fix it on spline input shaft. It depends on the needs and wishes of e.g. the calculation group whether the clutch disc should be mounted or not.

If the transmission is new, it shall be subjected to a running-in program. It is preferred to perform run-in with torque according to Appendix C, C2. If test equipment is not available, running-in without torque is acceptable (see Appendix C, C1).

4.1.4 The measurement system and amplifiers shall be switched on for a 30 minutes warm-up phase before start of data acquisition, in order to achieve a stable operating temperature for the pre-test adjustment. The transmission and measurement devices have to keep operating temperature constant during the whole measurement.

4.2 Conditions.

4.2.1 Environmental Conditions. The measurement device shall have a constant temperature during the complete measurement to prevent a drift of the reset adjustment (see paragraph 4.1.4).

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 For a quick tutorial of the measurement process see Appendix E.

4.3.2 Adjust the oil temperature ($+80\text{ }^{\circ}\text{C}$ or other temperatures as agreed upon) with e.g. $n_{in} = 3000\text{ min}^{-1}$ (rpm) / 3rd or 4th gear.

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During the whole measurement a constant oil sump temperature $\pm 3\text{ }^{\circ}\text{C}$ is needed. This could be achieved by "air cooling or heating" via a fan. Effects to friction losses by heating or cooling shall be avoided e.g. tensions in transmission housing or bearings due to inhomogeneous surface temperature.

4.3.3 For every gear two measurements of spin down curves (with 3000 min^{-1} (rpm) and two measurements with 6000 min^{-1} (rpm) input speed) shall be performed. First series of measurement (all gears) starts with 3000 min^{-1} (rpm).

4.3.4 The transmission shall be accelerated from output side until input speed (n_{in}) 3000 min^{-1} (rpm) is reached. (n_{in} = speed at speed sensor e.g. ROD430).

4.3.5 The input speed needs to be stabilized, before the measurement starts.

4.3.6 Start the measurement and disengage gear. Keep output speed constant (moving car) and measure deceleration of input shaft.

4.3.7 Run measurement until speed of input shaft has stabilized. Save data, stop output and engage the next gear and accelerate transmission again until 3000 min^{-1} input speed.

4.3.8 After all gears are measured, repeat 4.3.4 to 4.3.7 with 6000 min^{-1} (rpm) input speed.

4.3.9 Two measurements shall be performed per test series. If input speed curves deviate by $> 2\%$, a further measurement shall be performed.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. The measurement gives conclusion for internal friction of manual transmission systems. It may give an advice for possible shifting problems.

5.3 Test Documentation. The measurement results shall be evaluated graphically (see Appendix D) and in tabular form. The diagrams shall facilitate comparative statements concerning the reproducibility of results as well as a determination of interrelationships between individual parameters and the deceleration.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

DCT	double clutch transmission
FWD	front wheel drive
RWD	rear wheel drive
MTA	manual transmission automated shifted
min^{-1}	revolution per minute
n_{in}, n_{out}	input / output speed
rpm	revolutions per minute, engine speed in min^{-1}

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW16915

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