



Neutral Losses Measurement Manual Transmissions (Coast Down for FWD/RWD application)

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 Test Procedure is to measure the friction losses of manual transmissions (MT) and automated manual transmission (MTA) for front wheel drive (FWD) and rear wheel drive (RWD) application when engaged in neutral and output is decelerating like a coast down maneuver in the car. The measurement provides data for calculation of vehicle coast down tests (road load determinations).

1.2 Applicability. Manual transmission (MT) and automated manual transmission (MTA) for front wheel drive (FWD) and rear wheel drive (RWD) application.

1.2.1 The emission and fuel consumption department required this method to measure on a bench the inner losses of an MT while coast down, to calculate the road load of a defined vehicle.

1.3 Remarks. The transmission losses in neutral depend on various parameters such as rotational speed, bearing losses, oil type, lubrication system, temperature and structure. It is hence a requirement for aimed improvements that respective loss contributions are known. This test procedure describes a method to measure drag torque of manual transmission when in neutral similar to the coast down of a car. Measurements are made on the output side of the gearbox.

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
- 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 Test stand with gearbox flange in assembly position, two electric engines 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). See assembly test stand set-up in attachment (see Appendix A).

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3.2 Equipment. (See Appendix A).

3.2.1 Two (2) torque transducer ($M_{\max} = 50 \text{ Nm}$) with non linearity hysteresis $\leq 0.05 \%$ (e.g. HBM T10F or better one, e.g. T12).

3.2.2 Speed sensor for input and output with an accuracy $\leq 0.03 \%$ (e.g. HBM T10F or better one, e.g. T12).

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

3.2.4 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).

3.2.5 Oil temperature sensor (e.g. NiCrNi) with an accuracy $\pm 2.5 \text{ }^{\circ}\text{C}$.

3.3 Test Vehicle/Test Piece. Complete FWD or RWD transmission without clutch system.

3.4 Test Time.

Calendar time: 2 days including run-in

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 for the transmission. 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, paragraph C2. If the test equipment is not available, running-in without torque (see Appendix C, paragraph C1) is acceptable.

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 before the pre-test adjustment. During the pre-test adjustment it is necessary to reset the amplifiers without force on the gauge bar (remove side shaft for amplifier reset). Therefore, the transmission and measurement devices have to have operating temperature that shall be 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.

4.2.2.1 As the principle of measurement is based on the elastic deformation of the measuring shaft, all temperature fluctuations and distortions of the measuring shaft shall be avoided. Any shaft misalignments shall be corrected by suitable couplings.

4.3 Instructions.

4.3.1 Adjust the oil temperature with e.g. $n_{\text{in}} = 1000 \text{ min}^{-1} \text{ (rpm)}$ in 5th or 6th gear. If not otherwise specified (e.g. BOD) adjust oil temperature at $+80 \text{ }^{\circ}\text{C}$ (or $+40 \text{ }^{\circ}\text{C}$). During the whole measurement a constant oil sump temperature $\pm 3 \text{ }^{\circ}\text{C}$ is required. This could be achieved by "air cooling or heating" via a fan. Effects to inner losses by heating or cooling shall be avoided e.g. tensions in transmission housing or bearings due to inhomogeneous surface temperature.

4.3.2 Flow diagram and arithmetic mean curve see Appendix D.

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4.3.3 Set the input speed n_{in} to a constant value e.g. 700 min⁻¹ (rpm) (idle speed of a combustion engine, no gear shifted) if no other value was agreed upon.

4.3.4 Start the data recording.

4.3.5 Drive an accelerating ramp at the side shaft with an acceleration rate of 50 min⁻¹/s from 0 min⁻¹ to 1700 min⁻¹, if no other value was agreed upon.

4.3.6 Wait 10 s.

4.3.7 Drive a decelerating ramp of the side shaft with the same acceleration rate as in 4.3.5 down to 0 min⁻¹.

4.3.8 Stop data recording.

4.3.9 The arithmetic mean of both curves reflects the static torque value. This calculation requires a constant and equal deceleration and acceleration (see Appendix D).

4.3.10 Execute three (3) measurements per test. If they show disparities of $\geq 1\%$, a further measurement shall be performed.

5 Data

5.1 Calculations. An evaluation tool is required, which at first separates the recorded data into an acceleration and a deceleration. Then it calculates the arithmetic mean of both curves. The result is a torque as a function of the output speed.

5.2 Interpretation of Results. The measurement gives conclusion for internal friction at manual transmission systems. Additional it gives an advice for possible shifting problems.

5.3 Test Documentation. The measurement results shall be evaluated graphically (curve, 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 drag torque.

For the error assessment, a detailed error calculation shall be provided that includes all errors caused by the measuring chain.

For an example of the error assessment of the measuring chain see Appendix E.

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.

FWD	front wheel drive
RWD	rear wheel drive
M_{max}	maximum torque
M_{in}, M_{out}	input / output torque
MT	manual transmission
MTA	manual transmission automated shifted
min⁻¹	revolution per minute
min⁻¹/s	acceleration of min ⁻¹
n_{in}, n_{out}	input / output speed
rpm	revolutions per minute, engine speed in min ⁻¹

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8 Coding System

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

Test to GMW16918

9 Release and Revisions

This standard was originated in January 2013. It was first approved by MT System PMT in April 2014. It was first published in April 2014.

Issue	Publication Date	Description (Organization)
1	APR 2014	Initial publication.
2	DEC 2017	Revised 3.2.4, 3.5, 4.3.2, 4.3.4 through 4.3.9, 5.1, 5.3 and Appendix E. Updated 3.4 Calendar time. Added 3.6.1, 3.6.2, 4.1.1 and 4.1.2 and Appendix B. Renumbered and revised 4.1 and 4.3. (Global Propulsion Systems - Transmission Development/Validation Engineering)

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