Manual Transmission and Drivetrain – Strength in Reverse Gears Rear Wheel Drive Vehicles Only

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 evaluation of manual transmission/transaxle drivetrain strength in reverse gears during drive and overrun conditions.

1.2 Applicability. Passenger cars, Multipurpose Vehicles (MPV) and light-duty trucks (with Two Wheel Drive (2WD), Four Wheel Drive (4WD), and All-Wheel-Drive (AWD)) in Primary Rear Wheel Drive Driveline vehicles.

1.3 Remarks. This test is usually used for validation in a vehicle test plan. It may also be used to give an initial evaluation of drivetrain strength in development phases. This test is also used by platform measurement groups to define procedures for obtaining maximum loads for powertrain interface systems, such as engine mounts. The project team is responsible to ensure that this test is executed as specified. Deviations from the requirements shall have been agreed upon within the responsible project team.

1.3.1 The Test Summary.

1.3.1.1 Drive Direction Launches. Three (3) cycles in drive direction with snap clutch engagement launches each at 1000 rpm, 2000 rpm; 3000 rpm and 4000 rpm in reverse gear.

1.3.1.2 Overruns. Ten (10) cycles with engine at idle speed performance each at 5 km/h; 10 km/h; 20 km/h and 30 km/h (approximately 3 mph, 6 mph, 12 mph and 18 mph). All performed with quick clutch engagement. Maximum vehicle speed is 75% of the maximum permissible engine speed in the gear to be tested (reverse gear).

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

2.3 Additional References.

Analysis, Development and Validation (ADV) Plan

Statement of Requirement (SOR)

Subsystem Technical Specifications (SSTS)

Validation Cross Reference index (VCRI)

Vehicle Technical Specification (VTS)

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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 Use the following (or frictional equivalent) in order of preference:

3.1.3.1 GM certified proving ground or equivalent automotive test facility.

3.1.3.2 Test to be performed on even level, dry antiskid pavement (concrete or asphalt with constant friction characteristics).

3.2 Equipment.

3.2.1 Optional for Development. Torque measurement instrumentation, such as propshaft or torque wheels (preferred) and appropriate recording equipment.

3.2.2 Calibrated tachometer or other means of measuring accurate engine speed.

3.2.3 Instrumentation to measure transmission sump temperature.

3.2.4 Precision vehicle speed recording equipment or calibrated vehicle speedometer.

3.3 Test Vehicle/Test Piece.

3.3.1 Test material (i.e., transmission, axle, propshaft, etc.) installed in a vehicle representative of production or test intent. Validation specifications are set using untested components.

3.3.2 Tires. Tires that give the highest driveshaft reaction torque, if available. This is typically the largest diameter released tire size; however, other factors, such as tread design, tread width, etc., may influence this.

Note: New tires shall be run in.

3.3.3 Engine. The regular production option available having the highest torque.

3.3.4 Transmission. The regular production option available producing the highest driveshaft reaction torque.

3.3.5 Axle. Use axle drive with limited slip differential if released, otherwise regular.

3.3.5.1 Drive Direction. The lowest numerical ratio released for the engine/transmission combination listed in 3.3.3 and 3.3.4 that gives the highest driveshaft reaction torque.

3.3.5.2 Overrun Direction. The highest numerical ratio released for the engine/transmission combination listed in 3.3.3 and 3.3.4 that gives the highest driveshaft reaction torque.

3.3.6 Clutch. Highest capacity released clutch for the engine/transmission combination listed in 3.3.3 and 3.3.4. It must be qualified for the print high-tolerance pressure-plate load. This is the maximum pressure-plate load a new clutch package could have, not the maximum possible pressure-plate load with a worn-out disk.

Note: New clutches shall be run in

3.3.7 Driver Assistance Systems. Switch driver assistance systems to standard conditions (i.e. electronic stability program and traction control to ON, adaptive ride chassis to NORMAL, STOP and START to ON). Other than standard settings shall be denoted.

3.3.8 Hardware Requirements/Test Pieces.

3.3.8.1 The launch and over-run portion comprise one (1) test procedure.

3.3.8.2 One (1) set of hardware must pass the drive and one (1) set of hardware must pass over-run portion of each test. In total, two (2) sets of hardware are required to perform one (1) complete test.

3.3.8.3 Based on regional requirements, it is accepted to perform drive and overrun portion with one (1) set of hardware only. This has to be communicated and agreed within the project team.

3.3.8.4 These requirements do not apply to hardware validated to previous requirements.

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3.4 Test Time.

Calendar time:	3 days
Test time:	8 h
Coordination time:	16 h

3.5 Test Required Information.

- Analysis, Development and Validation (ADV) Plan.
- Statement of Requirement (SOR).
- Subsystem Technical Specifications (SSTS).
- Validation Cross Reference index (VCRI).
- Vehicle Technical Specification (VTS).
- Application Engineer.
- Development Groups.
- Drawings.

3.6 Personnel/Skills.

3.6.1 Trained and skilled test driver able to evaluate results and driveline noise according to GMW14264.

3.6.2 Have an understanding of driveline components and their characteristics.

3.6.3 Have the ability to conduct end of test inspection of test parts.

4 Procedure

4.1 Preparation.

4.1.1 Engineer Test Data. Engineer shall perform as follows and record on Appendix A, Data Sheet A1.

4.1.1.1 Determine and record who will disassemble components after test (e.g. GM or supplier).

4.1.1.2 Determine, record and supply correct tires and axle for Drive direction and Overrun direction tests. Record tire pressure specification.

4.1.1.3 Determine if wheel or propshaft torques shall be measured. This is more often done for development.

4.1.1.4 Record transmission excursion and stabilized maximum temperature desired on data sheet.

4.1.1.5 Specify road surfaces to use if differences in road friction coefficients may affect comparisons of two (2) different designs. Differences in coefficients shall range from 5% to 10%. See 3.1.

4.1.2 Pretest Inspections. Rate drivetrain for pretest noise according to GMW14264 and record on Appendix B, Data Sheet B1.

4.1.2.1 Place vehicle on hoist and inspect the following:

- Engine mounts.
- Suspension.
- Frame/body supports.
- Axle housing.
- Other reaction supporting members.
- Rate leaks using GMW14264.

4.1.3 Pretest Setup. As follows:

4.1.3.1 Install all instrumentation.

4.1.3.2 Remove clutch pedal pad.

4.1.3.3 Set tire pressure to specification on Appendix A, Data Sheet A1, record on Appendix B, Data Sheet B1.

Note: Different size tires may be required for Drive and Overrun portions of test.

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4.1.4 Vehicle Ballast.

4.1.4.1 Vehicles rated up to 2040 kg (approximately 4500 lb) towing capacity:

- 2/3 (approximately 66%) of carrying capacity (carrying capacity = Gross Vehicle Weight (GVW – Curb Weight with 100% options)).
- The drive axle shall be ballasted with maximum allowed axle weight.
- For AWD applications load each axle with 50% of calculated ballast.
- Ballast to be placed in intended storage area, such as passenger compartment or trunk.
- Stop at any ballast point if carrying capacity is reached.
- Secure the ballast, as required, to prevent movement during test execution.
- Record vehicle front and rear axle test weights on Appendix B, Data Sheet B1.

4.1.4.2 Vehicles rated > 2040 kg (approximately 4500 lb) towing capacity:

- 100% GVW.
- Ballast (including driver + equipment) to maximum rated front and rear axle capacity with total loading not to exceed total rated GVW.
- Ballast to be placed in intended storage area such as passenger compartment or trunk.
- Stop at any ballast point if carrying capacity is reached.
- Secure the ballast, as required, to prevent movement during test execution.
- Record vehicle front and rear axle test weights on Appendix B, Data Sheet B1.

4.1.5 Break-in. Recommended for new engines, and transmissions. For new axles a break-in is mandatory. Perform in such case as follows:

4.1.5.1 Accelerate lightly, while up-shifting lightly, to 100 km/h (approximately 60 mph).

4.1.5.2 Vary speed 80 km to 100 km/h [approximately 50 mph to 60 mph] for 5 km (approximately 3 miles) in top gear.

4.1.5.3 Decelerate lightly, while lightly downshifting, to a stop.

4.1.5.4 Repeat cycles from 4.1.5.1 thru 4.1.5.3 for a distance of 200 km.

4.1.5.5 Engage reverse gear and accelerate Wide Open Throttle (WOT) to 25 km/h.

4.1.5.6 Then decelerate lightly to a stop.

4.1.5.7 Repeat reverse gear portion of break in ten (10) times.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Road surface shall be dry.

4.2.1.1.1 Temperatures.

- Ambient temperature shall be between -5 °C and 30 °C.
- Road surface temperature shall be above ambient temperature at start of test, but not exceed melting point of asphalt. It is recommended to measure and denote road surface temperature at beginning and end of test.
- Tire temperature shall be above road temperature, but not exceed graining temperature. It is recommended to measure and denote tire temperature at beginning and end of test.
- Transmission/transaxle oil sump temperature shall be at 60 °C minimum at the start of the test.

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 If traction control is available as a “driver selected option,” it must be turned on during the test.

4.2.2.2 If vehicle powerhops during launch, contact the test engineer for determination whether to mitigate it or to complete the test with powerhop. Comment on method of mitigation in Appendix B, Data Sheet B1.

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