GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW16641

Active AWD/4WD Low Coefficient of Friction (Winter) 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. Provide a common global development and validation performance evaluation of a passenger vehicle that utilizes All Wheel Drive (AWD) or active Four Wheel Drive (4WD) technology.

1.2 Applicability. For vehicles equipped with AWD systems and Active Transfer (T) Cases.

The procedures contained in this document are specific to low coefficient of friction (μ) conditions and should not be considered all-inclusive for AWD systems and Active T Case validation requirements.

1.3 Remarks. This procedure defines the vehicle maneuvers required to develop/validate the software and calibrations that are used to control the active coupling technology transfer cases that transfer torque from the primary drive axle to the secondary drive axle.

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/Validation (ADV) Plan
- CANape Software Tools, Vector Informatik, based in Stuttgart, Germany, www.vector.com
- CG3504 Data Log, Active T Case Low Coefficient of Friction (Winter) Test
- Component Technical Specifications (CTS) for Rear Differential Control Module (RDCM)/Transfer Case Control Module (TCCM)
- Engineering Tools, Application and Services (ETAS) Group, based in Stuttgart, Germany, www.etas.com
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS) for electronic Limited Slip Differential (eLSD)/Rear Drive Module (RDM) (active)/T Case (active)
- Validation Cross-Reference Index (VCRI)
- Vehicle Technical Specification (VTS)

3 Resources

3.1 Facilities. Winter test facility that includes:

a. Large, flat, smooth, low μ (packed snow or 0.3 μ basalt tile) area: 46 m × 92 m (150 ft × 300 ft).

b. Large, flat, smooth, low μ (ice or 0.1 μ ceramic tile) area: 46 m × 92 m (150 ft × 300 ft).

c. Hill, 12%, split μ (high μ/low μ) front/rear and left/right.

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d. Hill, 20%, split μ (high μ/low μ) front/rear and left/right.

Note: High μ should be pavement, asphalt, or equivalent; low μ should be ice, wet tile or equivalent.

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.

3.2 Equipment.

3.2.1 CANape (software tool) Data system or equivalent (available from Vector Informatik).

3.2.2 ETAS Data system (optional) (available from ETAS Group).

3.3 Test Vehicle/Test Piece. Test vehicle with production representative driveline.

3.3.1 Test Vehicle. Vehicle shall be equipped with specific driveline configuration requested. It may be possible to interchange driveline, chassis controls, wheels/tires and powertrain hardware/software to accomplish multiple test configurations on the same vehicle.

3.3.1.1 All available combinations of engine, transmission, final drive ratios, tires and propulsion combinations may need to be tested separately due to differences in driveline reactions and other hardware/electronic influences. Consult requesting engineer to determine objective of test and required combination(s) of the systems to meet test objectives.

3.3.1.2 Wheels and tires used during testing should be the Original Equipment Manufacturer (OEM) recommended/required type (brand, size, construction, etc.) Although required in many regions, **snow** tires often do not react similarly on artificial surfaces as compared to actual low μ (winter) test surfaces (in this case, **snow** tires must be tested on actual ice surfaces).

3.3.2 Vehicle Ballast. Production intent vehicle curb weight plus driver and equipment. Other ballast/trailer conditions can be tested if requested. Document vehicle mass condition on data sheet.

3.3.3 Drivetrain Hardware. All drivetrain hardware that is being evaluated should be in undamaged condition.

All drivetrain hardware that is being tested for validation purposes should be **new** or have < 500 km of accumulated general usage (without abuse testing). If hardware has > 250 km, no additional break-in is required. Otherwise, see 4.1.4 for break-in procedure. Evaluations using this test procedure can be performed using hardware with higher mileage for informational or development purposes.

3.4 Test Time.

Calendar time:	5 days
Test hours:	16 hours
Coordination hours:	8 hours

3.5 Test Required Information.

Possible sources are:

- Statement of Requirements (SOR)
- Vehicle Technical Specification (VTS)
- Subsystem Technical Specification (SSTS)
- Analysis/Development/Validation (ADV) Plan
- Validation Cross-Reference Index (VCRI)
- Application Engineer
- Development Groups
- Drawings

3.6 Personnel/Skills. A trained driver/technician or engineer should conduct this test evaluation who is able to maneuver the vehicle according to the driving sequences listed herein, and induce behavior on test vehicle for the purposes of evaluating the response. In addition, a person who has the ability to evaluate vehicle response with respect to calibration of Active Clutch Control System and who has the ability to conduct end of test inspection of test parts if required.

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4 Procedure

4.1 Preparation.

4.1.1 Set tire pressure to specifications.

4.1.2 Check all fluid levels. Fill as required.

4.1.3 Put vehicle on hoist and conduct inspection on all driveline torque carrying components. Inspection should note any leaks, or unusual conditions.

4.1.4 Break-In. A break-in is recommended for new engines and transmissions. Break-in is mandatory if a new axle is installed for test or the test vehicle/axle has accumulated < 200 km of usage.

4.1.4.1 Complete break-in as follows:

- Accelerate lightly to 100 km/h, and then vary vehicle speed between 100 km/h and 125 km/h for a total of 10 km.
- Use light braking to bring vehicle to a stop.
- Repeat cycles as previous until a distance of 200 km is attained. A minimum of 200 km is mandatory if rear axle is included in the validation.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Dry high μ surface and simulated/actual low μ surface (wet ceramic tiles/ice). Reference Table 1.

Table 1: Road Surface Coefficients

Road Surface	Peak Friction Coefficient (μ)	Example Road Surface
High coefficient	μ > 0.8	Dry Asphalt/Dry Concrete
Medium coefficient	0.4 < μ < 0.7	Wet Jennite or Wet Basalt/Packed Snow
Low coefficient	μ < 0.3	Wet Ice, Wet Ceramic Tile or Wet Polished Concrete/Ice
Split coefficient	Road surface with different peak friction coefficients under left and right driven wheels (e.g., low and high or medium and high peak friction coefficient combinations only)	

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 Selectable Transfer Cases – AWD Mode. Shift the transfer case into the AWD mode. Perform 4.3.1.1 through 4.3.1.16 with Traction Control System (TCS) and Vehicle Stability Control (VSC) both active and deactivated.

4.3.1.1 Low μ Accelerations.

4.3.1.1.1 Accelerations from Stop. On a low μ surface, accelerate from a stationary position in a straight line using 30% throttle. Dwell for 5 s at 15 km/h, 30 km/h and 50 km/h (10 mph, 20 mph and 30 mph) during each launch cycle. Repeat procedure at 60% throttle and Wide Open Throttle (WOT).

Accelerate from a stationary position in a straight line using 30% throttle. Dwell for 5 s at 15 km/h, 30 km/h and 50 km/h (10 mph, 20 mph and 30 mph) followed by WOT during each launch cycle.

Accelerate from a stationary position in a straight line to 3500 rpm. Perform a quick throttle lift.

4.3.1.1.2 Rolling Accelerations. Repeat 4.3.1.1.1 using rolling starts.

In addition, complete rolling starts with:

- At approximately 30 km/h (20 mph), throttle lift, ¼ (90 degree) steering wheel turn to Right (R), then downshift

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