



Driveline Torsional Impact 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. The purpose of this test procedure is to determine the driveline loads of two-wheel drive (2WD), four-wheel drive (4WD) and all-wheel drive (AWD) powertrain components when subjected to a wide open throttle (WOT) impact cycling test, producing high loads resulting from multiple vehicle launches on low μ (friction) and split μ surfaces.

1.2 Applicability. All passenger cars and light trucks. AWD, front wheel drive (FWD), rear wheel drive (RWD) and 4WD can be tested.

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, whereas required consolidation may apply at engineer's discretion, in particular with regard to total number of test pieces.

Deviations from the requirements shall have been agreed upon within the responsible project team.

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
- Feature Technical Specification (FTS)
- Statement of Requirements (SOR)
- Subsystem Technical Specification (SSTS)
- System Design Failure Mode and Effects Analysis (DFMEA)
- System Technical Specification (STS)
- Validation Cross Reference Index (VCRI)
- Vehicle Technical Specification (VTS)

3 Resources

3.1 Facilities. Low μ (ceramic tiles) test surfaces or on ice at the Winter Test Facility (Kinross, Michigan or equivalent) with adjacent dry pavement surface creating a split μ . See 4.2 for low μ and high μ surface definitions. The test surface for homogenous low μ consists of the area of the low μ test area large enough to accelerate and decelerate the vehicle without transitioning to high μ .

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

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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 Thermocouples to monitor transmission lubricant sump temperatures.

3.2.2 Data recording equipment.

3.2.3 Strain-gauged half shaft(s) to measure driveline torque. Calibrate each shaft to two times the yield strength (contact program Design Release Engineer (DRE) for yield strength numbers) and make sure instrumentation gain is also set to account for these higher than normal loads.

3.2.4 Optional. Thermocouples to monitor ambient air temperature, engine oil sump temperature, axle lubricant temperature and transfer case fluid temperature (if so equipped).

3.2.5 Data Acquisition System (DAS). The DAS is used for recording vehicle communication bus, e.g., Controller Area Network (CAN), Local Interconnect Network (LIN), etc., channels and instrumented driveline or chassis controller channels (if requested/necessary). The vehicle communication bus shall be recorded at full bus speed, e.g., Global A CAN is 500 kbit/s, but individual modules on the bus may have slower update rates as compared to overall vehicle bus. The DAS shall have, at a minimum, a recording speed matching the fastest communication bus rate for all data channels.

Note: When recording digital data or external analog data it should be broadcast and recorded at a sample rate of no less than 500 Hz. Examples of external data include throttle pedal position and axle torque.

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

Note: All available combinations of engine, transmission, AWD, final drive ratios, i.e., all possible propulsion systems (i.e., Start/Stop Technology), and tire and wheel combinations (including spare tire) may need to be tested separately, due to differences in driveline reactions and other hardware or electronic influences. Consult the Requesting Engineer for the test objectives and required combinations required to meet the test objectives.

Note: Tire and wheel combinations should be the Original Equipment Manufacturer (OEM) recommended type, i.e., brand, size, construction, etc. Although required in many regions, **snow** tires often do not react similarly on artificial surfaces (ceramic tiles) as compared to actual low μ (ice) test surfaces. Snow tires must be tested on actual low μ (ice) surfaces.

3.3.1 The released combination of powertrain components that creates the greatest loading on the test component(s).

3.3.2 Tires, as released for the test vehicle, which produce maximum tractive effort.

3.3.3 For Road Load Data Acquisition (RLDA) testing, it is not necessary to test multiple samples. Additional samples may be requested.

3.3.4 Ensure all test components conform to design specifications.

Note: All instrumentation is to be calibrated as required; record instrumentation details and date of calibration unless the information is otherwise preserved in the instrumentation records. See Data Sheet A1, Appendix A.

3.4 Test Time.

Calendar time: 3 days

Test hours: 8 hours

Coordination hours: 16 hours

3.5 Test Required Information. Possible sources are:

- Statement of Requirements (SOR)
- Vehicle Technical Specification (VTS)
- Feature Technical Specification (FTS)
- System Technical Specification (STS)
- System Design Failure Mode and Effects Analysis (DFMEA)

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- Subsystem Technical Specification (SSTS)
- Analysis/Development/Validation (ADV) Plan
- Validation Cross Reference Index (VCRI)
- Application Engineer
- Development Groups
- Drawings

3.6 Personnel/Skills. Trained driver. Ability to conduct end of test inspection of test parts if required.

4 Procedure

4.1 Preparation.

4.1.1 Determine and record the number of accelerations, throttle pedal positions and chassis/driveline mode combinations to be tested based on requirements in 3.5 or as required by Requesting Engineer. Document the test configuration on Data Sheets A2 and A3 in Appendix A. Multiple copies of Data Sheet A3 may be required to document test modes.

The Requesting Engineer may call for electronically limited lower speeds (rpm) be performed in order to measure driveline torque values at several points less than maximum allowable speeds (rpm). This will require the assistance of a calibrator who can electronically establish a desired maximum rpm and implement this temporary calibration into the vehicle for each desired lower rpm torque measurement.

Provide the following:

- Fleet Number or Vehicle Identification Number (VIN)
- Vehicle configuration
- Test surface (simulated or actual low μ surface) and any special temperature requirements

4.1.2 Install instrumentation for recording test data as required by Requesting Engineer. The following channels being critical to most tests:

- Vehicle bus (critical signals)
- Wheel speeds (all wheels)
- Transmission gear state (or ratio)
- Throttle pedal position
- Estimated torque signals (if available, i.e., anything pertaining to driveline engine/hybrid systems)
- Traction/stability control status
- Anti-lock Brake System (ABS) status
- User selected modes effecting driveline/vehicle performance
- Vehicle acceleration

4.1.3 Set tire pressure to specifications.

4.1.4 Check all fluid levels. Fill as required.

4.1.5 Inspect all driveline torque carrying components with vehicle on hoist. Record any leaks or unusual conditions on Data Sheet A2 in Appendix A using the subjective scales of GMW14264.

4.2 Conditions. Road surface coefficients are defined in Table 1.

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