GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17154

Passenger Car Power Hop Evaluation

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 is for a vehicle performance assessment relative to the vehicle's tendency to power hop in either the forward or reverse direction. It can also be used to gather data for use in computer models and/or Hardware in Loop (HIL) simulations to evaluate and correlate power hop behavior on high horsepower vehicles. Finally, it can be used to evaluate the performance of vehicle components (axles and propeller (prop) shafts, etc.) after being subjected to severe loads resulting from induced power hop.

1.2 Applicability. Passenger cars and light trucks.

1.3 Remarks. This test is typically run by GM Test Operations Group and the Driveline Development Group. It is used for development of the drivetrain and suspension. This system includes but, is not limited to, driveshaft, half shafts, axles, sub frame and suspension bushings, dampers, tires, etc.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14233

2.3 Additional References.

- Analysis/Development/Validation (ADV) Plan (ID).
- Calibration and diagnostic software file(s) with GM internal variables (ID).
- Drawings (ID).
- Statement of Requirements (SOR) (ID).
- Subsystem Technical Specification (SSTS) (ID).
- Validation Cross Reference Index (VCRI) (ID).
- Vehicle Technical Specification (VTS) (ID).

(ID) = This item is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

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 Milford Proving Ground (MPG). Oval Track section located between mile marker 2.2 and 2.4, Durability Skid Pad or Military Straight drag launch pad.

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3.1.4 Desert Proving Ground Yuma (DPGY). 1.4 Mile Straightaway, i.e., access road adjacent to the straightaway.

3.1.5 Prepared Surface. As required by program management team or VTS.

3.2 Equipment. Data logger for recording analog signal data, Controller Area Network (CAN) channels, messages and signals and an instrumented Integrated Chassis Control Module (ICCM) for electronic Limited Slip Differential (eLSD) equipped vehicles. The CAN messages should represent the control modules that request, command and respond torque values of powertrain and driveline mechanized components. If a required signal is not in the CAN message of a specific control module, and the control module has internal signals to meet test requirements, then an instrumented module will be required.

Note: All instrumentation shall be calibrated as required. Record instrumentation details and date of calibration on Data Sheet A1 in Appendix A, unless information is maintained in the testing laboratory records.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Vehicle. Selection of a "worst-case" vehicle for this test is a matter of engineering judgment. Power hop is a complex vibratory phenomenon which generally involves the entire powertrain (engine, transmission, half-shafts and/or prop shaft), as well as the suspension and powertrain mounts. A vehicle's susceptibility to this phenomenon is a function of numerous spring-mass-geometry relationships and cannot readily be predicted. Past testing has indicated the following trends:

- Hop intensity is generally proportional to tractive ability of a vehicle; hence, high-performance engines, high axle ratios, limited slip differentials, high-traction tires are generally worst case.
- For front engine, rear wheel drive vehicles, manual transmission is usually worst case.
- Low-travel engine-transmission/transaxle mountings generally give worst case power hop.

3.3.2 Significant Parameters. The following guidelines are not intended to exclude any model vehicle from analysis, but are meant to aid in the selection of the most significant vehicle parameters:

- Highest available torque engine.
- Wheels and tires that produce the highest rotating inertia (typically the largest released diameter and highest mass wheel/tire combination).
- Tires that produce the highest tractive effort (if torque wheels are not being used for data collection).
- Lowest numerical overall drive ratio.

3.3.3 Vehicle Ballast. Production intent vehicle curb weight plus driver and equipment.

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

3.4 Test Time.

Calendar time:	10 d
Test time:	1 h
Coordination time:	2 h
Vehicle Preparation:	9 d

3.5 Test Required Information. Refer to Data Sheet A2 in Appendix A. Possible sources are:

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- ADV Plan (ID)
- Application Engineer.
- Development Group(s).
- Drawings (ID).
- SOR (ID).
- SSTS (ID).
- VCRI (ID).
- VTS (ID).

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3.6 Personnel/Skills. This test evaluation should be conducted by a trained driver who is able to induce power hop behavior on test vehicle and a person who has the ability to conduct end of test inspection of test parts if required.

4 Procedure

4.1 Preparation. Refer to Data Sheets A2 and A3 in Appendix A.

4.1.1 Determine and record the number of test starts (as defined in 4.3) required for the test per the Requesting Engineer.

4.1.2 Install instrumentation for recording vehicle data if required.

Note: All instrumentation shall be calibrated as required. Record instrumentation details and date of calibration on Data Sheet A1 in Appendix A, unless information is maintained in the testing laboratory records.

4.1.3 Record the following data channels if the data obtained is to be used for subsequent computer model and/or HIL work:

- Rear wheel force transducers channels (12 channels, force and moment).
- Rear wheel angular displacement using slip ring.
- Left and right half-shaft torque.
- Left and right slip angle or velocity at differential.
- Rotational angle input of prop into differential.
- Rotational angle output of half-shafts from differential.
- Rear Magnetorheological (MR) damper current (if so equipped).
- Accelerator Pedal Position or percentage.
- Rear damper displacements (ride height sensor signal can be used to get a translated displacement of how far the damper rods have moved). **Note:** Need to measure the location of ride height sensors relative to dampers.
- Engine speed.
- Body vertical acceleration at seat track.
- Rear Drive Module (RDM) mount deflections.
- Electronic Brake Control Module (EBCM) messages and signals (if applicable).
- Clutch torque command and response from Transfer Case Control Module (TCCM) (if applicable).
- Clutch torque command from control module of eLSD (eLSD equipped vehicles).
- Install an instrumented ICCM on the car (eLSD equipped vehicles).
- Confirm calibration and diagnostic software file(s) with GM internal variables (eLSD equipped vehicles).

4.1.4 Disable the traction/stability control systems by pulling the Antilock Brake System (ABS) pump fuse unless a power hop suppression algorithm is being evaluated.

4.1.5 Record tire pressure specifications and set the pressure to recommended specifications.

4.1.6 Check all fluid levels. Fill as required.

4.1.7 Put vehicle on hoist and conduct inspection on the following:

- Engine mounts (especially for front wheel drive (FWD) vehicles).
- Axle shafts and Constant Velocity (CV) joints.
- Propeller (Prop) shaft.
- Suspension (including dampers).
- Frame and body supports.
- Axle housing.
- Other reaction supporting members.

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