



Hill Start Capability (Launch on Grade)

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. To evaluate a vehicle's ability to perform a hill start (launch from a stop on various grade hills) under different conditions such as altitude and temperature. Evaluation also includes hill starts with a trailer.

1.2 Applicability. This procedure applies to passenger cars and light-duty trucks equipped with automatic or manual transmissions. Automatic transmissions include, but are not limited to, continuously variable transmissions (CVT), double-clutch transmissions, or Manual Transmission Automatic (MTA) types.

1.3 Remarks. This procedure:

- Is used to evaluate a vehicle to the Hill Start Capability Vehicle Technical Specification (VTS) paragraph.
- Evaluates the drive quality aspects of hill starts such as maximum clutch engagement times tolerated by the customer (equal to a certain minimum acceleration during launch).
- Includes evaluation of powertrain behavior under different ambient conditions (temperatures, altitudes, grades, etc.) Ambient and test conditions may vary with the intended sales markets for the vehicle. Consult the program's Vehicle Technical Specifications for the proper test severity to apply for any configuration.
- Does NOT replace existing component tests (e.g., for clutch durability).
- Only considers the powertrain and related drive quality aspects of hill starts. Thus, it excludes other areas such as cooling, chassis, and brakes.

Note: European Directive 92/21/EEC (as amended by 95/48/EC) refers to limited requirements for Hill Start Capability.

2 References

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

2.1 External Standards/Specifications.

92/21/EEC (95/48/EC)

2.2 GM Standards/Specifications.

GMW14555

2.3 Additional References.

- CG2580 Equivalent Test Condition Severity Level Calculator for GMW15751 Hill Start Capability.
- Global Notice of Action (NOA) 440 (Inlet Air Temperature (IAT) Strategy/Requirement).
- Hill Start Capability VTS.
- Owner's Manual.
- Program Vehicle Technical Specifications.

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May 2015

Page 1 of 10



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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 Road Tests shall be conducted on the following recommended road surface as follows:

- The road must be dry, clean, smooth, and free from undulations. The road surface shall be concrete or rolled asphalt.
- The road should be straight.
- The track must be of sufficient length to perform the test.
- The facility grade, temperature and altitude per requesting engineer in 3.5.1.

3.2 Equipment.

Note: The following is a recommended list of all equipment used in various tests. See each test for actual equipment used.

3.2.1 Vehicle Speed Measurement Device. A speed measurement device, e.g., calibrated fifth wheel or an optical sensor shall be securely mounted to the vehicle.

3.2.2 Accelerometer Assembly (optional). An accelerometer with a range of $\pm 2.0G$, an accuracy of $\pm 1.0\%$, and a resolution of $0.005G$ is required. The accelerometer must be adjustable in-line with the longitudinal axis of the vehicle. A leveling bubble may be used as a visual indication for leveling the plate in the horizontal plane. The accelerometer could be used to verify or measure the grade that the vehicle is on (note that it will also measure fore/aft acceleration).

3.2.3 Tachometer. An engine tachometer with an accuracy of $\pm 0.15\%$ and a resolution of 10 rpm is required unless Control Area Network (CAN) data or equivalent is available.

3.2.4 Data Acquisition System. A data acquisition system (DAC) capable of recording all the test parameters, within a time base accuracy of $\pm 0.1\%$ of the total sample time interval is required. The DAC must be capable of storing all the test parameters at a minimum rate of 100 samples per second for 2 minutes with a resolution of $1/2048$.

3.2.5 Vehicle Scales. Scales capable of measuring vehicle weight to an accuracy of ± 3 kg (5 lb). A copy of the scale print report should be obtained for reference.

3.2.6 Tire Pressure Gage. Tire pressure gage to measure tire pressure with an accuracy of ± 5 kPa (1 psi).

3.2.7 Surface Gage. A surface gage, Starrett Model 257B or equivalent, will be used to assist in measuring pedal displacement.

3.2.8 Safety Equipment. Check with the test facility for safety equipment requirements.

Note: All instrumentation shall be calibrated as required. Record instrumentation details and date of calibration on data sheet, unless information is otherwise preserved in the testing facility records.

3.2.9 Temperature Measurement. Devices to measure intake air (required), coolant (optional), oil (optional) and ambient temperatures (required) or CAN bus can be used if available as needed. Measured air temperature in clutch housing (optional but highly recommended) may be used to ensure appropriate preconditioning of the clutch and serve as an indicator for critical component temperatures during test execution.

3.2.10 Transmission/Engine Speed. Instrumentation to measure transmission output speed and engine speed or CAN bus data if available (optional for development and data analysis purposes).

3.2.11 Pedal Force Transducer (or Equivalent). Auto Transmission: To determine when foot is off brake to determine start-of-test time or CAN bus can be used, if available.

3.2.12 Clutch Pedal Sensor (or Equivalent). To measure clutch engagement. CAN bus can be used if available.

3.3 Test Vehicle/Test Piece. The following vehicle requirements are expected of the Requesting Engineer.

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May 2015

Page 2 of 10

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3.3.1 Engine.

- Ensure that the engine is tuned, timed, and calibrated to the manufacturer's specification.
- The engine torque must be within the specification. It is recommended to determine the individual test engine's full load torque curve in vehicle. The engine should be broken-in for a minimum of 2000 km, or as specified by the requesting engineer. Record break-in deviations.
- Record the engine computer control system calibration code in the test record.

3.3.2 Tires. The tire tread bars must not be showing and the tread must be in good condition. The tires should be broken-in for a minimum of 200 km, or as specified by the requesting engineer. Record break-in deviations.

3.3.3 Rear Axle (if applicable). The rear axle should be broken-in a minimum of 200 km with frequent shifting, or as specified by the requesting engineer. Record break-in deviations.

3.3.4 Throttle System. Verify that the throttle pedal and throttle plate can open to specified maximum limit (which is not necessarily 100% opening). This may require an on-road evaluation. Ensure that the floor mats are to design and do not restrict pedal travel.

3.3.5 Transmission/Clutch.

- All: The transmission should be broken-in a minimum of 200 km with frequent shifting. Record break-in deviations.
- Automatic Transmission. Record the transmission calibration code in the test record.
- Manual transmission:
 - a. A measured clutch pressure plate shall be installed; pressure force must be within the specification. If available, parts with minimum clamp forces should be used.
 - b. Clutch: The clutch shall be broken in. The following break-in or equivalent may be used.
 1. Launch in 1st Gear at 40% engine rpm maximum.
 2. Shift sequentially up through all forward gears at 80% engine rpm maximum.
 3. Shift sequentially down through all forward gears with target rpm at end of shift 95% engine rpm maximum.
 4. Limit break in to prevent wheel spin and maximum vehicle speed of 160 km/h.
 5. Repeat Launch and Shift Sequence 20 times.
 6. Allow clutch to cool before beginning test.

3.3.6 Brakes. Ensure that brake drag is not excessive. This may be done with the vehicle on a hoist by turning the wheels and looking for excessive drag.

3.3.7 Exterior Trim/Camouflage. Record any variations or exceptions to the exterior trim configuration that may affect test results. Evaluate the effects of camouflage as the camouflage may act as insulation or block air flow.

3.3.8 Fuel. Record if a different fuel is required. Fuel shall conform to the manufacturer's recommendation for the weather conditions in which the vehicle is being tested. Consult the owner's manual for recommendations.

3.3.8.1 Gasoline. The test fuel should be commercially available and of the required grade, unleaded regular, or premium, as required.

3.3.8.2 Diesel. Test fuel should be commercially available and of the required grade.

3.3.9 Lubricants. Vehicle lubricants shall conform to the manufacturer's recommendation for the predominant weather conditions in which the vehicle is being tested. Consult the owner's manual for recommendations.

3.4 Test Time.

Calendar time: 1 day

Test hours: 8 h

Coordination hours: 2 h

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Page 3 of 10



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