



Global Vehicle Top Gear Gradeability 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. This dynamometer based test procedure measures dynamic disturbances associated with the powertrain system while driving up a simulated constant grade. Tests are run incrementally at 90 km/h, 105 km/h, and 120 km/h.

This data is used by Drive Quality (DQ) Test to measure performance to the Vehicle Technical Specification (VTS) requirement for Top Gear Gradeability (TGG).

1.2 Applicability. This procedure applies to passenger cars and light-duty trucks equipped with automatic transmissions.

1.3 Remarks. This procedure is written for use with a full vehicle dynamometer setup, and is not intended to be done "on road".

Utilizing a dynamometer for this test provides for:

- An infinite number of grades.
- A direct measurement of gradeability.
- Improved test repeatability when compared to on-road measurement.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- United States Environmental Protection Agency (EPA).
- Vehicle Technical Specification (VTS) requirement for Top Gear Gradeability (TGG).

3 Resources

3.1 Facilities. This procedure is written for testing a full vehicle on a spindle coupled or chassis roll type dynamometer.

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. Testing will be conducted with an external (test cell) cooling fan placed in front of vehicle. The larger the cooling fan, the better for maintaining stable engine operating temperatures during testing. A fan with a minimum flow of 4719.5 L/s (10 000 ft³/minute (CFM)) is recommended.

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July 2015

Page 1 of 5

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time.

Calendar time:	0 days
Test hours:	1 h to 2 h
Coordination hours:	0 h

3.5 Test Required Information. Vehicle Test Weight Class, as defined by the United States Environmental Protection Agency (EPA).

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation.

4.1.1 Vehicle Preparation. Verify the vehicle's engine and transmission calibrations are correct and record the numbers.

Verify that the correct test fuel and tire pressures are present.

4.1.2 Test Preparation. Dynamometer will be run in Simulation Mode (load dependent on 3-term road load coefficients, simulated grade percentage, and test weight). Determination and correction for existing vehicle/dynamometer losses shall be carried out prior to this testing.

Vehicle traction control or vehicle stability systems must be disabled prior to initiating testing.

4.2 Conditions.

4.2.1 Environmental Conditions. Testing will be conducted in a temperature controlled dynamometer room with an ambient temperature of 19 °C to 25 °C.

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 Vehicle Conditions.

- Vehicle shall have all electrical accessories turned off, including air conditioning, blower, radio, and headlights.
- Vehicle should be sufficiently warmed-up prior to start of testing. It is critical that the engine oil temperature be stabilized around 90 °C before and during testing.
- Operation of the vehicle's cooling fan during testing is undesirable and must be monitored. If the fan should turn on during testing, the test results are considered void and the test must be re-run.

4.3 Instructions.

Step 1: Vehicle target speed control shall be done manually by the dynamometer operator/driver or by a robotic driver. Cruise control shall not be used to hold speed for this testing.

Step 2: The vehicle will be accelerated to a steady-state speed and allowed to stabilize at that speed prior to applying grade. Test runs will be conducted from three steady-state starting speeds of 90 km/h, 105 km/h, and 120 km/h.

Step 3: In order to avoid overheating the vehicle, it is advised that the operator determine the approximate grade that will result in an "event" (defined as either an unlock of the Torque Converter Clutch (TCC)) or a transmission gear downshift. Do this by using a "fast" grade ramp rate of 0.05%/s (1% every 20 s). Start from 0% grade and continue ramping in additional grade until a shift/TCC event occurs. Note the grade. Reset 0% grade and allow the vehicle to cool. Use a target oil temperature of 90 °C as a maximum for starting a test. If required, vehicle speed may be reduced to allow for faster cooling.

Step 4: Reset the desired test speed (90 km/h, 105 km/h, or 120 km/h).

Step 5: Ramp the grade using the fast rate to a value that is 0.5% to 1.0% below the target identified in the preceding Step 3. Allow the vehicle speed to stabilize. Note the engine speed (min^{-1} (rpm)) at this point.

Step 6: Begin to apply additional grade at a "slow" constant rate of 0.01%/s (1% every 100 s).

Step 7: Monitor engine speed. An "event" has occurred once a step change ($> 250 \text{ min}^{-1}$ (250 rpm)) is noted in the engine speed. End the test at this point.

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Page 2 of 5