



Ice Capability Brake 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 test procedure is for determining the braking force required to prevent wheel spin at high idle with a slippery road surface.

1.2 Applicability. Passenger cars, multipurpose vehicles and light duty trucks equipped with automatic transmissions and Rear Wheel Drive (RWD) or All Wheel Drive (AWD).

1.3 Remarks. This test was originally developed utilizing an iced over surface or an ice rink. Due to the uncontrollable variation in the coefficient of friction of the ice surface, test repeatability was poor. Revisions were made to this procedure eliminating the dependency on ice surface qualities; thus, providing highly repeatable measurements. Because this test is now run with zero friction at the tires, it represents worst case conditions.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15102

3 Resources

3.1 Facilities. Any indoor or outdoor facility that has provisions for testing a vehicle suspended on jack stands and can provide ambient temperatures required to achieve engine cold idle.

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 Engine tachometer.

3.2.2 Front and rear line pressure transducers.

3.2.3 Pedal force transducer.

3.2.4 Digital data acquisition system.

3.2.5 Friction material temperature measuring set up using embedded thermocouples.

3.2.6 Wheel speed sensor transducers on drive axle(s).

3.3 Test Vehicle/Test Piece. Test vehicle with proper powertrain and service brake system.

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3.4 Test Time.

Calendar time: 1 day to 3 days
Test time: 12 hours to 16 hours
Coordination time: 3 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. A test engineer or technician trained to perform this test.

4 Procedure

4.1 Preparation.

4.1.1 Install front and rear line pressure transducer downstream of any proportioning device.

4.1.2 Install highest nominal axle ratio for vehicle model and engine configuration or the axle ratio specified in the test request. The adjustment calculation in 5.1.1 may be used if the test vehicle axle ratio is not the highest (worst case).

4.1.3 Bleed the entire brake system including any bypass or proportioning device.

4.1.4 Install the pedal force transducer.

4.1.5 Connect the pedal force transducer and speedometer output to data acquisition system and calibrate as required.

4.1.6 Record a brake line pressure versus pedal force effort curve.

4.1.7 Install friction material temperature thermocouples and readouts. An example of a typical thermocouple installation is shown in Appendix A, Figure A1.

4.1.8 Check the engine thoroughly for proper operation and calibration. Record engine calibration and related software.

4.1.9 Burnish the brakes following the brake burnish procedure in GMW15102.

4.2 Conditions.

4.2.1 Environmental Conditions. Ambient temperatures must be low enough to cause engine to run at high idle after 4 h soak. If proper engine idle speeds can be obtained by electronic interfacing, then the ambient temperature requirement would not apply.

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 Test request should state the appropriate transfer case selection (e.g., 4HI, 4LO, 2HI) and the automatic gear selection to be used for the test. As a default, use 2HI (4HI for AWD) and Drive gear.

4.2.2.2 Initial brake temperatures on the drive axle should not be greater than 40 °C for each test run, unless otherwise specified.

4.2.2.3 The data acquisition system should trigger to stop data collection at 2 km/h for any wheel, unless otherwise specified.

4.3 Instructions.

4.3.1 Pedal Force Required to Stop Wheel Rotation at Engine Idle.

4.3.1.1 On flat, level surface, place vehicle on approved jack stands and secure.

4.3.1.2 Raise drive axle enough to provide a minimum of 50 mm tire to road surface clearance. For AWD vehicles, raise front and rear axles to give tires adequate tire to road surface clearance.

4.3.1.3 Start the engine according to the recommended cold start procedure in the Owner's Manual. Do not depress the accelerator or brake pedal unless specified.

4.3.1.4 Record cold idle engine speed. See example data sheet in Appendix A, Data Sheet A1.

4.3.1.5 Without pressing the brake pedal, if possible, shift into Drive or requested gear. To avoid using brake on vehicles with Brake Transmission Shift Interlock (BTSI), start engine with shift selector in neutral.

4.3.1.6 Idle the engine; do not use the accelerator pedal.

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4.3.1.7 Attain equilibrium engine speed.

4.3.1.8 Apply the brake pedal until no drive axle wheel spin occurs (speedometer input is zero). Record the pedal force, brake line pressures, and brake temperatures.

4.3.2 Engine Speed Required to Spin Wheels at Applied Brake Pedal Force.

4.3.2.1 Leave the vehicle in position and wait for requested brake temperature to be reached.

4.3.2.2 Without pressing the brake pedal, shift into neutral.

4.3.2.3 Allow the engine speed to stabilize at idle speed.

4.3.2.4 Apply a brake pedal force specified in the test request. As a default, use 50 N as the initial pedal force.

4.3.2.5 Shift into drive or requested gear and check for drive wheel spin. Increase engine speed using the accelerator pedal until first wheel spin or the engine speed stops increasing. Record the engine speed, the brake line just prior to first wheel spin.

4.3.2.6 Repeat 4.3.2.1 thru 4.3.2.5 using increasing pedal forces until a no wheel spin occurs. As a default, increase the pedal force by 50 N for each run.

5 Data

5.1 Calculations.

5.1.1 The following adjustment calculation may be used if the worst-case axle ratio was not installed on the test vehicle. The minimum speed at which wheel spin is allowed should be specified in the test request. As a default, 1200 rpm may be used.

$$\frac{(\text{Adjusted Minimum Speed})^2}{(\text{Minimum Speed @ Allowed Spin})^2} = \frac{\text{Worst Case Ratio}}{\text{Test Ratio}}$$

5.1.2 Tabulate the pedal force, engine speed, brake line pressure, and brake temperature data in a table. See Appendix A, Data Sheet A1.

5.1.3 Plot the engine speed and average rear line pressure at wheel spin versus pedal force for engine speeds less than 2000 rpm. See Appendix A, Figure A2 for an example graph.

5.2 Interpretation of Results. Test results should be compared to the applicable technical specification requirements or to the results for other vehicles.

5.3 Test Documentation. Results and test information should be published in an engineering report stored in the Global Document Management (GDM) System.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

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