GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17832

Global High Speed Brake Abuse 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 standard is to describe the high-speed brake abuse test for vehicles that use premium brake hardware.

1.2 Applicability. Passenger cars, light duty trucks, and light duty multipurpose vehicles that use premium brake hardware.

1.3 Remarks. This test can be combined with other vehicle tests to reduce test properties.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14927 GMW15102

3 Resources

3.1 Facilities. Test area that provides a long, level, and straight paved road with high-speed turnaround capability.

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 Vehicle weighing station providing at least the mass (weight) per each axle.

3.1.4 Vehicle ballast station.

3.2 Equipment.

3.2.1 Speed measurement device with capability to capture initial speed and stopping distance. The speed transducer must be capable of reading velocity in excess of the vehicle test speed. The transducer accuracy must be within 0.5 km/h over the speed range of 5 km/h to 90% vehicle maximum speed (Vmax) The transducer accuracy shall measure distance within ± 0.2%.

3.2.2 Brake pedal force transducer accurate within 2 N with full scale output of 1100 N.

3.2.3 Brake pedal travel measurement.

3.2.4 Brake booster vacuum measurement.

3.2.5 Decelerometer accurate within 0.09 m/s^2 (0.01 G) with full scale output of 19.62 m/s^2 (2.0 G).

3.2.6 Driver-readable deceleration indicator scaled to a minimum of 11.71 m/s^2 (1.2 G).

3.2.7 Thermocouples installed in the brake pads and/or linings.

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3.2.8 Optional instrumentation may be used to measure hydraulic line pressure, rotor temperature, brake fluid temperature, and yaw rate. Torque wheels may be used, but should not be used at test speeds beyond torque wheel speed rating.

Note: The different vent area of the torque wheel may affect the brake temperatures and foundation brake performance.

3.2.9 Digital data acquisition system with 100 Hz sample rate for all channels.

3.2.10 Calibration Record. All instrumentation is to be calibrated as required. Record instrumentation details and calibration dates in the testing records.

3.3 Test Vehicle/Test Piece. In selection of the test vehicle, consideration is to be given to the combination of axle ratio, type and size of tires, type of wheels and wheel covers, engine, body type and front-to-rear mass (weight) distribution. The test vehicle should be representative of the extreme characteristics of the vehicle family.

3.4 Test Time.

Calendar time:	2 d to 3 d
Test time:	4 h
Coordination time:	4 h to 8 h

3.5 Test Required Information. The ambient temperature will affect the cooling during the fade tests. Always document the ambient temperature in the test record and use engineering judgement when comparing results from tests run at significantly different ambient conditions.

3.6 Personnel/Skills. An experienced, trained brake tester capable of performing the vehicle setup and driving instructions in Section 4 is required.

4 Procedure

4.1 Preparation.

4.1.1 Document basic information such as vehicle make, model, year, Vehicle Identification Number, mileage, car number and full brake system, tire and wheel description in the test record.

4.1.2 Build brake system per test request, as provided by Requesting Engineer. The initial brake build should be new hardware unless specified otherwise by requesting engineer.

4.1.3 Install the instrumentation, including any optional equipment specified in the test request.

4.1.3.1 For brake pad and lining temperature, thermocouple installation shall follow instructions GMW15102.

4.1.3.1.1 Use plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one (1) per brake. For brake drum shoe, recess the thermocouple 1.0 mm under the surface. For disc brake pad, recess the thermocouple 2.0 mm under the surface. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the metal rubbing surface of a drum or rotor. For center-grooved shoes or pads, thermocouples are installed within 3 mm to 6 mm of the groove and as close to the center as possible.

4.1.3.2 If the optional brake line pressure transducers are requested perform the following.

4.1.3.2.1 Install the instrumentation needed to perform a floor check: pedal force, pedal travel, booster vacuum transducers, and data acquisition system.

4.1.3.2.2 Perform a floor check following instructions in GMW14927.

4.1.3.2.3 Install brake line pressure transducers.

4.1.3.2.4 Perform a floor check following instructions in GMW14927 recording the brake line pressure with the data specified in 4.1.4.1.

4.1.3.2.5 Compare the pedal travel at 90 N of pedal force in the floor check with line pressure transducers to the same travel in the floor check before the installation of brake line pressure transducers. If the pedal travel increased, use floor checks and brake bleeds, as required, to restore pedal travel to the pre-instrumentation level.

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4.1.4 Fill fuel tank to capacity. Maintain fuel level above 75% during the testing.

4.1.5 Adjust tire pressure to manufacture's specifications and record. Ensure tire speed rating at test pressure meets or exceeds test speed.

4.1.6 All vehicle openings are to be closed except as required for instrumentation or ventilation. Record any exceptions.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 The ambient temperature should be between -10 °C and 40 °C.

4.2.1.2 Wind speed should be less than 32 km/h in any direction.

4.2.1.3 The track surface must be dry.

4.2.1.4 All tests sections should be performed at elevations < 500 m above sea level.

4.2.1.5 Record temperature, barometric pressure, relative humidity, wind speed and wind direction at time of testing in the test record.

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 Activate the digital data acquisition system at least 0.5 s before each brake pedal application and deactivate when the vehicle has stopped.

4.2.2.2 Brake applies must be made with transmission in drive for automatic transmission vehicles or with clutch disengaged for manual transmission vehicles.

4.2.2.3 The brake pedal force shall be ≤ 1000 N. Apply necessary pedal force as fast as possible to achieve Antilock Brake System (ABS) actuation or optimal wheel slip.

4.3 Instructions.

4.3.1 Load vehicle to Gross Vehicle Mass (GVM) condition.

4.3.2 Perform a brake burnish following instructions from the test engineer. The default brake burnish is the burnish specified in GMW15102.

4.3.3 Load vehicle to Lightly Loaded Vehicle Mass (LLVM) condition.

4.3.4 The test speed should be 90% of Vmax or 160 km/h (100 mph), whichever is lower. If the vehicle maximum speed is not known, use the following method to determine the maximum speed for this test.

4.3.4.1 Accelerate at a maximum rate, Wide Open Throttle (WOT), from a standing start for 3.2 km on a level surface. Record the maximum speed.

4.3.4.2 Repeat 4.3.4.2.1. in the opposite direction on the straight-away or at a position 180 degrees from the first run if using the circular track.

4.3.4.3 The average of the two (2) maximum speed measurements is the maximum speed for this test.

4.3.5 Drive vehicle to test track.

4.3.6 Prepare instrumentation to record data during the snubs. Record all requested data channels for each snub.

4.3.7 Perform 2.0 m/s^2 (0.2 G) snubs from 80 km/h to 30 km/h (50 mph to 20 mph) until the front brake temperatures reach an Initial Brake Temperature (IBT) of 66 °C to 77 °C (150 °F to 170 °F).

4.3.8 Accelerate at WOT to test speed. The test should be run with transmission in highest gear that the test speed is attainable.

4.3.9 Activate the digital data acquisition system at least 0.5 s before brake pedal application.

4.3.10 Apply brake pedal force at high apply rate to target deceleration of 6 m/s^2 (0.62 G). The test driver should modulate the pedal force as required to maintain 6 m/s^2 (0.62 G) throughout stop. Maintain deceleration until the vehicle comes to a stop (pedal force may be backed off when the vehicle is below 10 kph speed to avoid jarring and uncomfortable dynamics at end of stop). Steering correction to maintain a 3.5 m lane is allowed.

4.3.11 Repeat steps 4.3.8 through 4.3.10 at 1.6 km (1.0 mi) intervals until a total of 20 stops are completed. Accelerate at WOT after the stop is completed to the target test speed and hold the test speed until 1.6 km (1.0 mi) has been covered relative to the start of acceleration for the previous cycle. If the test speed is not

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