European High Speed Fade 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 braking fade test for up level vehicles in Europe.

1.2 Applicability. Up level passenger vehicles and light duty trucks and multipurpose vehicles sold in Europe.

1.3 Remarks. This test should be performed on up level programs sold in Europe. 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. Due to maximum speed limitations at the Milford Proving Ground (MPG), this procedure may require the use of another facility depending on the top speed capability of the test vehicle.

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 80% Vehicle Maximum Speed (Vmax). The transducer accuracy shall measure distance within ± 0.2%.

3.2.2 Decelerometer accurate within 0.1 m/s^2 (0.01 g) with full scale output of 19.61 m/s^2 (2.0 g).

3.2.3 Driver-readable deceleration indicator scaled to a minimum of 11.77 m/s^2 (1.2 g).

3.2.4 Optional instrumentation may be used to measure brake pedal force, pedal travel, hydraulic line pressure, brake lining temperature, rotor temperature, brake fluid temperature, yaw rate, and booster vacuum. 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.

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

3.2.6 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:	12 h to 16 h
Test time:	4 h
Coordination time:	2 days to 4 days

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 set up and driving instructions in paragraph 4 is required.

4 Procedure

4.1 Preparation.

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

4.1.2 Build brake system per test request. 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 If optional temperature measurements are made on the brake pads and linings, thermocouple installation shall follow instructions per 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 per GMW14927.

4.1.3.2.3 Install brake line pressure transducers.

4.1.3.2.4 Perform a floor check per GMW14927 recording the brake line pressure.

4.1.3.2.5 Compare the pedal travel at 90 N 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.

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

4.1.5 Adjust tire pressure to manufacturer's specifications for comfort/normal 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.

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4.1.7 Ensure that all safety requirements for the test facility are followed for the 80% maximum test speed.

4.2 Conditions.

4.2.1 Environmental Conditions.

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

4.2.1.2 Wind speed shall 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 .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.

Note: 0.8 vmax = 0,8 x vmax → vmax as specified by the manufacturer.

4.3.1 Load the vehicle to the Lightly Loaded Vehicle Mass (LLVM) condition (see 7.1).

4.3.2 Brake and Tire Burnish. The following brake conditioning schedule is required:

4.3.2.1 Accelerate at Wide Open Throttle (WOT) to 150 km/h and hold for 1.6 km.

4.3.2.2 Perform 2.9 m/s^2 (.29 g) snub to 50 km/h.

4.3.2.3 Repeat 4.3.2.1 and 4.3.2.2 seven (7) additional times.

4.3.2.4 Accelerate at WOT to 90 km/h and hold for 1.6 km.

4.3.2.5 Perform 0.9 m/s^2 (.09 g) stop from 80 km/h to zero speed.

4.3.2.6 Repeat 4.3.2.4. and 4.3.2.5 six (6) additional times increasing the deceleration by 0.9 m/s^2 (.29 g) until 6.8 m/s^2 (.69 g) is reached.

4.3.2.7 Repeat 4.3.2.6 two (2) additional times.

4.3.2.8 Accelerate to 90 km/h and cool brakes to 80 °C.

4.3.2.9 Repeat 4.3.2.6 through 4.3.2.8 five (5) additional times.

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

4.3.4 Drive vehicle to test track.

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

4.3.6 Make nine (9) brake snubs from 0.8 v_{max} to 70 km/h at 5 m/s^2 (.50 g) deceleration.

4.3.6.1 An Initial Brake Transfer (IBT) of < 80 °C on the front discs should be established before the first snub. No IBT is specified for the subsequent stops.

4.3.6.2 Apply necessary pedal force as fast as possible to achieve 5 m/s^2 (.50 g) deceleration. Modulate pedal force as necessary to maintain 5 m/s^2 (.50 g) deceleration.

4.3.6.3 Immediately following each snub, accelerate at WOT and start next snub upon reaching 0.8 v_{max}.

4.3.7 Make one (1) brake stop from 0.8 v_{max} to 0 km/h to achieve minimum stopping distance.

4.3.7.1 Conduct stop with transmission in drive for automatic transmission vehicles or with clutch disengaged for manual transmission vehicles.

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