



Auto Motor und Sport (AMS) Press Prediction Brake Evaluation

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 standard describes the method to test brake performance in a manner similar to that used by Auto Motor und Sport (AMS) magazine published in Europe.

1.2 Applicability. Passenger vehicles, light duty trucks, and multipurpose vehicles sold in Europe.

1.3 Remarks. This revision was developed based on information obtained from the test staff of AMS in 2015. This revision also addresses testing requirements to measure vehicle stopping distance as specified in GMW14983 (Brakes – Vehicle Stopping Distance).

2 References

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

2.1 External Standards/Specifications.

ASTM E1136 ASTM E1337

2.2 GM Standards/Specifications.

GMW14927 GMW14983 GMW15102

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 Test Track. The track should be a flat, level surface (< 1% grade in any direction) with adequate length and with a minimum of a 3.7 m (12 ft) lane. Stopping distance test area shall be defined in such a manner as to allow expedient surface friction measurements.

3.1.4 Vehicle Weighing Station. To provide measurements of at least the front and rear axle and ballast materials.

3.1.5 Wheel alignment measurements and adjustment facility (optional).

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 (V_{max}). The transducer accuracy shall measure distance within $\pm 0.2\%$.

3.2.2 Track peak coefficient of friction measurement equipment.

3.2.3 Driver-readable deceleration indicator scaled to a minimum of 12.0 m/s^2 .

3.2.4 Rotor temperature measurement via laser interferometer.

3.2.5 Track surface temperature measurement equipment.

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Documents

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3.2.6 Optional instrumentation may be used to measure deceleration, brake pedal force, pedal travel, hydraulic line pressure, 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. Review test request for instructions.

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

3.2.8 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.

3.3.1 The specific vehicle chosen for testing should be representative with respect to brake system, tires, suspension, and mass distribution properties.

3.3.2 If equipped with an Antilock Brake System (ABS), the ABS hardware, software, and calibration levels should be documented for all non-production vehicles.

3.3.3 Tires selected for the test should be new and should have a date of manufacture less than one year from test date.

3.3.4 The suspension adjustments such as caster, camber, and toe-in should be set to manufacturer's recommended specification at test loading conditions. The suspension components such as shocks, springs, dampers, etc., should be correct for the vehicle being tested.

3.3.5 Engine and transmission calibrations should be correct to ensure vacuum and drag levels are correct. Record the engine and transmission software and calibration levels.

3.4 Test Time.

Calendar time: 2 days to 3 days

Test time: 4 hours

Coordination time: 4 hours to 8 hours

3.5 Test Required Information. The ambient temperature will affect the cooling during repeated brake applies. 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. This test requires an experienced, trained brake tester capable of performing the vehicle setup and driving instructions in Section 4.

4 Procedure

4.1 Preparation.

4.1.1 Review test request for test specifics as defined by the requesting engineer.

4.1.2 List vehicle data and brake system data in the test record.

4.1.3 Install thermocouples at each brake corner at the center of the most heavily loaded shoe or pad following instructions in GMW15102.

4.1.4 Build test vehicle with the brake hardware specified in the test request.

4.1.5 Build test vehicle with the tires specified in the test request.

4.1.6 Check inflation pressure of tires and set to requested pressure. If target pressure is not provided in the test request, use manufacturer's recommended pressure.

4.1.7 Fill fuel to capacity as noted in test request. If not stated, fill between $\frac{3}{4}$ and full capacity. Check all other vehicle fluid levels (oil, coolant, washer fluid, etc.) and fill to maximum manufacturer's recommended capacity.

4.1.8 Set vehicle to vehicle weight as specified in the test request.

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

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

4.1.9.2 Perform a floor check following instructions in GMW14927.

4.1.9.3 Install brake line pressure transducers.

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4.1.9.4 Perform a floor check following instructions in GMW14927 recording the brake line pressure.

4.1.9.5 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.

4.1.10 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. Record all environmental conditions on the test results data sheet, reference Appendix A, Figure A1.

4.2.1.1 Ambient temperature shall be between 5 °C and 40 °C and its variation during a sequence of measurements should not exceed 10 °C. For tires intended for summer use only, ambient temperature shall be between 10 °C and 55 °C. Record the ambient temperature.

4.2.1.2 The ambient wind velocity in the direction of travel shall not exceed 10 km/h. For wind velocity in the range of 10 km/h to 18 km/h, alternate runs in both driving directions. Do not run if wind speed exceeds 18 km/h.

4.2.1.3 Sun Load. Record the estimated percent sun load during the test with comments. Clear = 100%, full heavy cloud cover = 0%, making note of the atmospheric cloud conditions.

4.2.1.4 Track Surface Temperature. Track surface temperature shall be between 5 °C and 55 °C and its variation during a sequence of measurements shall not exceed 10 °C. For tires intended for summer use only, test track temperature shall be between 10 °C and 55 °C. Record the track surface temperature. Review test request or consult request engineer for any restrictions on track surface temperature.

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 For dry asphalt stopping distance measurements, the road surface coefficient shall be measured with an ASTM E1136 standard reference tire in accordance with ASTM E1337 method, at a speed of 64.4 km/h (40 mph) at the time of test. Exceptions must be approved by the request engineer.

4.2.2.2 Vehicles with an automatic transmission should have selector control in highest forward gear during stops.

4.2.2.3 Vehicles with a manual transmission should disengage the clutch before the stops.

4.2.2.4 All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) should be closed except as required for instrumentation purposes and ventilation.

4.2.2.5 All vehicle accessories should be off during stops.

4.2.2.6 Center vehicle in the roadway at the start of each stop. Steering control is allowed during the stops.

4.2.2.7 No lockup of any wheel is allowed for longer than 0.1 s at speeds > 15 km/h.

4.2.2.8 Stops are made without any part of the vehicle leaving the lane and without rotation of the vehicle about its vertical axis of $> \pm 15$ degrees from the centerline of the test lane at any time during the stop.

4.2.2.9 For vehicles equipped with ABS, apply a spike brake apply to activate ABS and maintain pedal force to keep ABS active. The spike apply rate should be a minimum of 6000 N/s and shall not exceed 12 000 N/s within the first 0.1 s after exceeding a force of 20 N. The minimum brake pedal force of 667 N shall be achieved within 0.2 s. After initial brake pedal application, the pedal force is held at a level > 667 N or higher if required to maintain ABS control.

4.2.2.10 For vehicles not equipped with ABS, a best effort stop is performed. Apply a spike brake apply to reach the maximum traction limit within 0.2 s. Then modulate the brake pedal force to maintain the highest deceleration without wheel lockup for longer than 0.1 s at speeds > 15 km/h.

4.3 Instructions.

4.3.1 Load the vehicle to the Lightly Loaded Vehicle Mass (LLVM) condition as defined in 7.1.

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

4.3.2.1 Accelerate at WOT to 150 km/h and hold for 1.6 km.

4.3.2.2 Perform 2.9 m/s² snub to 50 km/h.

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

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