



Brake Caliper Knockback and Pryback

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 procedure is to evaluate the brake pedal travel change when the vehicle is subjected to rough road driving conditions or lateral accelerations.

1.2 Applicability. This test is applicable to all passenger cars, multipurpose vehicles and light trucks.

1.3 Remarks. This procedure is intended to quantify the increase in brake pedal travel which occurs when the brake caliper piston changes location in the bore due to deflection and/or inertia of the brake components and their mountings.

This procedure measures the change in brake pedal travel using two (2) classifications: knockback from rough road inputs and pryback from lateral acceleration inputs.

This procedure includes a stopping distance test which shall be run if the increase in brake pedal travel from a rough road or pryback schedule is greater than the target value for that test section.

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

2.3 Additional References.

- Global Document Management (GDM) System (<https://documents.gm.com/gdm3/component/main>) (ID)
- Vehicle Technical Specification (VTS) (as applicable)

(ID) = This website is limited to internal access within General Motors and shall not be accessed outside the company. Contact the GM Lead Engineer for further instructions.

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.

3.1.2.1 A rough road, such as the Belgian Block Road at the GM Proving Ground, Milford, Michigan, or equivalent facility.

3.1.2.2 A level, smooth, high coefficient of friction straightaway for minimum stopping distance test.

3.1.2.3 A level, smooth, high coefficient facility with an area for a Figure Eight (8) drive course.

3.1.2.4 A track designed for lateral acceleration input such as the Seven Sisters Course at the Fenn Holden Test Area at GM Proving Ground, Milford, Michigan, or equivalent facility.

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3.1.2.5 A straight, corrugated road designed to reproduce the washboarding/corrugation/chatter bumps that occurs naturally on dirt roads. Acceptable facilities include the Washboard Road Facility, Fenn Holden Area at the GM Proving Ground, Milford, Michigan, or an equivalent facility. An acceptable facility must feature bumps with regular spacing and a constant bump frequency in the range of 15 Hz to 19 Hz at 50 km/h vehicle speed.

3.2 Equipment.

3.2.1 Brake pedal force transducer.

3.2.2 Brake pedal travel transducer.

3.2.3 Booster vacuum transducer.

3.2.4 Vehicle speed measurement equipment.

3.2.5 Distance measurement equipment capable of capturing the vehicle speed at stop initiation. (Only used for stopping distance test.)

3.2.6 Digital data acquisition system.

3.2.7 Appropriate signal conditioning equipment and cabling.

3.2.8 All instrumentation must be calibrated according to department policy. Record instrumentation identification numbers and calibration dates and store with the test information unless otherwise preserved by the test laboratory.

3.3 Test Vehicle/Test Piece.

3.3.1 The vehicle to be tested must be in a safe operating condition. All vehicle safety equipment must be in proper operating condition.

3.3.2 This test should be run with the service brake system in a simulated 50% worn condition to allow room in the caliper bore for knockback or pryback to occur. The test may be included in a sequence of brake tests on a single vehicle build while the brakes are in simulated 50% worn condition before any fade and abuse testing. To prepare brake pads for the simulated 50% worn condition, the pads are machined (mill cut) to 1 mm above half thickness of the friction material and then a 200 stop burnish is conducted (refer to GMW15102 section titled: Burnish).

3.3.3 Vehicles equipped with eboost are required to run procedure(s) both with and without power. Consult with test engineer for specific pedal force targets as they will differ from traditional vacuum apply systems.

3.4 Test Time.

Calendar time: 2 days to 3 days (vehicle use)

Test hours: 4 hours to 8 hours (on track)

Coordination hours: 4 hours to 6 hours

3.5 Test Required Information.

3.5.1 The test request shall specify the requested test sections and required instrumentation. If not specified, run all sections except the Seven Sisters course, with the stopping distance section only being run if indicated by the data results. The test sections may be run in any order.

3.5.2 Driving the Belgian Block course a few times before starting the test is recommended. During the test, the course is to be driven on average between 48 km/h and 56 km/h without application of the brake pedal or the parking brake. Speeds may need to be adjusted before downhill grades so that the vehicle is never over 56 km/h. Shifting to a lower gear is acceptable but is not encouraged. Shift to a lower gear only if throttle control alone will not maintain the test speeds. If using other facilities, driver should be familiar with the course before starting testing.

3.5.3 If running the stopping distance section of this procedure at the Milford Proving Ground, a safety spotter should be available to direct the test vehicle safely from the Belgian Block road course to the North-South Straightaway. The driver of the test vehicle may not use the service brake or the park brake when moving between facilities. If using other facilities, driver should follow all safety regulations of the facility. The brakes may not be applied when moving between the rough road facility and the stopping distance facility.

3.5.4 The Figure Eight (8) course should have sufficient drive off area around the course for safe recovery of the vehicle if necessary. Drivers should be familiar with the maneuvers.

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3.5.5 Drivers should be qualified for driving the Seven Sisters Course at the Fenn Holden Test Area or a similar equivalent course.

3.5.6 Driving the Washboard Road a few times before starting the test is recommended. During the test, the course is to be driven on average between 48 km/h and 56 km/h without application of the brake pedal or the parking brake, and the vehicle may need to be driven from the exit back to the entrances without application of the brake pedal or the parking brake. If using other facilities, driver should be familiar with the course before starting testing.

3.6 Personnel/Skills. A brake test technician qualified to perform the vehicle set up and the vehicle test instructions in Section 4. Advanced driver training may be required by the facility.

4 Procedure

4.1 Preparation.

4.1.1 Install brake pedal force transducer.

4.1.2 Install brake pedal travel transducer.

4.1.3 Install vacuum transducer on the booster side of the check valve (if applicable). If available, insert a bleed off valve or block in the vacuum line.

4.1.4 Install distance measurement equipment and readout Global Positioning System (GPS) or 5th wheel (this equipment should be removed while driving on the rough road and lateral input sections, and then be reinstalled just before the stopping distance test).

4.1.5 Install and connect signal conditioning and data acquisition system.

4.1.6 Calibrate and/or zero instrumentation as necessary.

4.1.7 Install new brake components (rotors, drums, calipers, and shoes). Brake caliper friction material used must be at a simulated (machined to) 50% worn condition (see 3.3.2)

4.1.8 Burnish the brake system according to GMW15102, section titled: Burnish.

4.1.9 Adjust the brakes to the vehicle manufacturer's specifications.

4.1.10 The test weight is to be the curb weight of the vehicle plus driver and instrumentation, unless otherwise specified. Measure the vehicle weight at each wheel.

4.1.11 Adjust tire pressure to vehicle manufacturer's specifications.

4.2 Conditions.

4.2.1 Environmental Conditions. Dry road conditions are required.

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.

4.3 Instructions.

Note: The instructions are for the GM Proving Ground, Milford, Michigan facility. These instructions should be modified only to the point necessary for testing at other facilities. All modifications should be recorded in the test record.

Note: The brakes are not to be applied during any test section, particular attention must be paid when exiting Seven Sisters test course due to the potential of other vehicle activity near the gate.

Note: Acceptable methods for deceleration and scrubbing off speed: drive in a circle or steer back and forth until the vehicle comes to rest. Down shifting with the transmission is also permitted. Drum-in-Hat (DIH) parking brakes may be used as well.

4.3.1 Rough Road Test – Belgian Block.

4.3.1.1 Drive the vehicle to the Belgian Block test facility.

4.3.1.2 Perform pretest procedure as in 4.3.5.

4.3.1.3 Make two (2) laps of the Belgian Blocks in drive gear maintaining vehicle speed between 48 km/h and 56 km/h. Control the throttle to maintain speeds under 56 km/h. If necessary, down shift the transmission to reduce vehicle speed. Do not apply the brake pedal. Do not use the park brake if integrated into the service brake.

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