



Brake Pad Compressibility

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 a laboratory based method to objectively assess brake pad compressibility.

1.2 Applicability. This standard is applicable to all disc brake pads.

1.3 Remarks. This standard is intended to assess the compressibility of a brake pad at two soak temperatures (+100 °C and +400 °C) over the pressure range of (30 to 12 000) kPa. This standard is based on two industry standards: SAE J2468 and ISO 6310. This procedure is intended to assess the performance of the brake pad under conditions similar to those experienced during vehicle use. The test results can be used as inputs to brake system analytical models.

2 References

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

2.1 External Standards/Specifications.

ISO 6310 SAE J2468

2.2 GM Standards/Specifications.

GMW14986

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 facility capable of maintaining test equipment and test hardware at $(+20 \pm 5)$ °C.

3.2 Equipment. The required equipment is listed in the following paragraphs.

3.2.1 Piston Simulator. Piston simulator with a mechanism to facilitate uniform loading across the piston simulator and pad backing plate. Piston simulators shall be representative of production caliper piston position and geometry at the pad backing plate/piston(s) interface.

3.2.2 Alignment. Equipment must maintain production representative pad and piston alignment throughout compressibility test.

3.2.3 Loading Device. A loading device is required to compress the test sample between the piston simulator and heating platen. Equipment loading capacity must be 55 kN minimum (allows for maximum piston simulator pressure of 13 MPa for a 2 mm x 51 mm piston simulator).

3.2.4 Load Control. The loading device must be capable of applying and releasing force at the equivalent piston(s) simulator pressure range of (5000 to 15 000) kPa/s with monotonic operation.

3.2.5 Apply Pressure. Instrumentation for measuring piston simulator pressure with an accuracy of 20 kPa.

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3.2.6 Deflection Measurement Device. A device for measuring piston simulator or pad deflection with an accuracy of 0.001 mm. Deflection measurement device shall exert < 1.0 N of force during measurement.

3.2.7 Heating Device. Heating device capable of maintaining the temperature of the heating platen at +100 °C and (+400 ± 10) °C.

3.2.8 Temperature Measurements. Instrumentation for measuring heating platen surface temperature and enclosed chamber temperature with an accuracy of 1 °C.

3.2.9 Data Acquisition. Data acquisition system capable of recording the following channels at 100 Hz during compressibility testing:

- Deflection (mm)
- Input force (N)
- Heating platen surface temperature (°C)
- Enclosed chamber temperature (°C)

3.2.10 Pad Thickness Measurement. Brake pad thickness measurement tool with 0.001 mm resolution as required per GMW14986.

3.2.11 Steel Plate. A 15 mm thick steel plate made of same material as the heating platen is required. Length, width, surface finish, and flatness of steel plate shall allow full surface contact between steel plate and piston simulator and between steel plate and heating platen during heating. This steel plate is intended to reduce the potential for heating platen damage during piston simulator baseline deflection measurements.

3.3 Test Vehicle/Test Piece. A minimum of fifteen samples shall be tested at +100 °C and 5 of the 15 samples shall be tested at +400 °C.

3.4 Test Time.

Calendar time: (2 to 3) days

Test hours: (4 to 6) h

Coordination hours: (4 to 6) h

3.5 Test Required Information. The test required information is listed in the following paragraphs.

3.5.1 Piston simulator inner diameter (shall be the same as the inner diameter of caliper piston at the pad backing plate/piston interface).

3.5.2 Piston simulator outer diameter (shall be the same as the outer diameter of caliper piston at the pad backing plate/piston interface).

3.5.3 Hydraulic caliper piston diameter(s).

3.5.4 Total hydraulic caliper piston area.

3.5.5 Piston simulator location (reproduce the position of the piston(s) as installed in the caliper).

3.5.6 Lining edge and batch code identification.

3.5.7 Noise insulator description.

3.5.8 Inboard or outboard pad assembly identification.

3.5.9 Pad backing plate thickness.

3.5.10 Pad assembly mass.

3.5.11 Lining bonding or mold method.

3.5.12 Underlayer description (if available).

3.5.13 Underlayer thickness (if available).

3.5.14 Lining contact area (area in contact with heating platen).

3.5.15 Lining material thickness from contact area to pad backing plate.

3.6 Personnel/Skills. One (1) technician trained in the operation of the test equipment and to perform the tasks listed in paragraph 4.

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4 Procedure

4.1 Preparation. The preparation required information is listed in the following paragraphs.

4.1.1 Pad Condition. Pad sample shall be brushed clean of debris generated during handling.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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 Nominal Temperature. The brake pad sample temperature shall be $(+20 \pm 5)$ °C prior to heating the pad sample and during GMW14986 pad assembly thickness measurements.

4.2.2.2 Elevated Temperatures. Testing at +100 °C and +400 °C shall be conducted in an enclosed chamber.

4.2.2.3 Pad Test Condition. Pads shall be tested in the new condition with production representative flatness and surface roughness, unless otherwise specified. For any other pad condition, the pads shall be ground such that contact surface flatness and surface finish is similar to new pad condition. Lining thickness shall be measured per GMW14986, with the exception of drilling measurement point holes, before and after grinding. Additionally, lining conditioning shall be noted.

4.2.2.4 Noise Insulator. Testing may be performed with or without noise insulators. The test information sheet, test data file, and test results summaries shall include a description of the noise insulator.

4.3 Instructions.

4.3.1 Label Test Parts. Label the pad sample with a unique identifier. Ensure the sample label will not be damaged during testing.

4.3.2 Measure Pad Thickness. Perform GMW14986, with the exception of drilling measurement point holes, to record pre-test pad assembly thickness with the brake pad at $(+20 \pm 5)$ °C.

4.3.3 Label Test Data File. Include an identifier for the test equipment, test sequence number, and the unique pad sample identifier along with +100 °C for the +100 °C test condition and +400 °C for the +400 °C test condition.

4.3.4 Piston Simulator Baseline Deflection Measurement. To ensure the accuracy of the test results, piston simulator deflection measurements shall be conducted at least annually. If the piston simulator deflection measurement has been conducted within one year, steps 4.3.4.1 to 4.3.4.3 may be omitted.

4.3.4.1 Install Steel Plate. Install the 15 mm thick steel plate and piston simulator. Position the deflection measurement device to measure piston simulator deflection.

4.3.4.2 Apply Preload. Apply (30 ± 10) kPa piston simulator pressure.

4.3.4.3 Perform Baseline Compressibility Measurement. The piston simulator deflection vs. pressure from the 3rd apply-release cycle is considered to be the Piston Simulator Baseline Deflection Curve.

4.3.5 Pad Compressibility Measurement, +100 °C Heating Platen Temperature.

4.3.5.1 Preheat Steel Platen. Heat the platen to +100 °C for a minimum of 10 minutes to allow for stabilization of the platen temperature.

4.3.5.2 Install Test Sample. Install the pad sample with the lining surface contacting the heating platen. Align the pad sample with the piston simulator, reproducing the position of the piston(s) as installed in the caliper.

4.3.5.3 Ten Minute Heating Cycle at +100 °C Heating Platen Temperature. Apply 30 kPa preload to the pad assembly. Measure heating platen surface temperature and enclosure temperature while heating the pad sample. Heat the pad sample for 10 minutes.

4.3.5.4 Pad Compressibility Measurement. Perform three ramp apply and release cycles after heating the pad sample with 30 kPa initial pressure, apply rate of (5000 ± 700) kPa/s, maximum pressure of 13 000 kPa, release time of < 10 s, release pressure hold time of 5 s, preload hold time of 10 s and maximum pressure hold time of 5 s.

4.3.6 Pad Compressibility Measurement, +400 °C Heating Platen Temperature. Perform 4.3.5 except at +400 °C.

4.3.7 Measure Pad Thickness. Remove brake pad from test chamber. Perform GMW14986 with the brake pad at $(+20 \pm 5)$ °C.

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