



Brake Pedal System Noise With Force and Temperature Cycling

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 is to test all components of the brake pedal system, excluding the pedal pad on the pedal plate, with respect to light duty fatigue, wear, noise and functional defects during temperature cycling in a climatic chamber.

1.2 Applicability. The test standard in this document is intended to be used in development and verification testing. The test procedures might also be used according to other circumstances where this type of testing could give useful information about component properties.

1.3 Remarks. The test standard describes the procedure for noise, fatigue and wear test of the brake pedal system during force and temperature cycling in a climatic chamber. The method can also be used to test components, such as brake booster, proportioning valves, calipers, slave cylinders, wire, pedal extension, etc.

Note: The applicable Subsystem Technical Specification (SSTS) or the Component Technical Specification (CTS) provides program specific information and acceptance criteria for systems/parts tested according to this procedure. In the event there is disagreement between this procedure and the SSTS/CTS, the SSTS/CTS shall take precedence.

2 References

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

2.1 External Standards/Specifications.

SAE J1100

2.2 GM Standards/Specifications.

GMW14048 (ID) GMW14155

(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

- Component Technical Specification (CTS)
- Global Document Management (GDM) System (<https://documents.gm.com/gdm3/component/main>) (ID)
- Subsystem Technical Specification (SSTS)

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

3 Resources

3.1 Facilities. Climatic chamber capable of cycling temperature from -30 °C to +80 °C with an ambient noise level less than 55 dBA.

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.

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3.2 Equipment.

3.2.1 Fixture.

3.2.2 Complete brake system (e.g. booster, master cylinder, Antilock Brake System (ABS) unit, brake pipe, brake caliper, brake lining).

3.2.3 Vacuum pump.

3.2.4 Pneumatic or hydraulic actuator with controller.

3.2.5 Force transducer.

3.2.6 Amplifier.

3.2.7 Microphone: 7.62 mm (0.25 in) or 15.24 mm (0.5 in) free-field measurement quality microphones (two (2) pieces).

3.2.8 Sound level calibrator.

3.2.9 Acoustical quality data acquisition system with minimum 44.1 kHz sampling rate and 16 bit quantization.

3.2.10 Data processing system capable of performing Zwicker loudness and sound pressure level calculations.

3.2.11 Instrumentation is to be calibrated as required. Record instrumentation details and calibration dates in the test record unless the information is otherwise preserved at the test laboratory.

3.3 Test Vehicle/Test Piece. Complete brake pedal system including attachment parts of the pedal module. At least three (3) parts shall be examined per test.

3.4 Test Time. Resource usage depends on the complexity of the testing and measurements. This is only as a guideline.

Calendar time: 15 days (or less)/three (3) pedal systems

Test hours: 250 hours

Coordination hours: 16 hours

3.5 Test Required Information. The test is to be performed according to the conditions given in SSTS/CTS or the test order.

3.6 Personnel/Skills. One technician capable of performing the duties described in Section 4 is required.

4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions. The test is to be performed according to the conditions given in SSTS/CTS or the test order.

4.2.1 Environmental Conditions. Temperature in climatic chamber shall cycle between -30 °C and +80 °C, including heating and cooling periods as shown in Appendix A, Figure A1.

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 The test conditions in 4.2.2.1.1 through 4.2.2.1.4 are common practice.

4.2.2.1.1 Number of total pedal force cycles should be at least 300 000 cycles per pedal system.

4.2.2.1.2 Pedal force cycling frequency should be 1 Hz.

Note: It is important that the pedal is released by the systems own spring force. No pedal pulling force shall be applied. For this reason, ball and socket is used in the test setup.

4.2.2.1.3 Pulsating pedal force should be a minimum force 1 N to 5 N and a maximum force 170 N.

Note: To prevent the ball from separating from the socket during the test, a minimum force is required.

4.2.2.1.4 When the test is running and the pedal is not emitting any objectionable sound, the ambient noise level should be less than 55 dBA.

4.3 Instructions.

4.3.1 General Instructions.

4.3.1.1 The brake pedal shall be tested together with a complete brake system and with a vacuum in the booster. Booster vacuum is 0.8 bar unless otherwise specified. See the SSTS/CTS for pipe length and vacuum levels.

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- 4.3.1.2** Mounting and adjustment of the parts to be tested shall be done in accordance with correct drawings.
- 4.3.1.3** The pedal-actuating angle shall be selected according to the vehicle type. See Appendix A, Figure A2.
- 4.3.1.4** The pedal actuator shall have a ball 10 mm to 15 mm, to connect to the socket mounted on the pedal plate according to Appendix A, Figure A3.
- 4.3.1.5** A ball joint shall be attached to the rear end of the cylinder. The ball joint shall be mounted in position according to Appendix, Figure A2.
- 4.3.1.6** Start temperature cycling according to conditions stated in Appendix A, Figure A1. The temperature cycle shall be repeated until the test is completed.
- 4.3.1.7** The pedal force cycling shall continue under the whole temperature cycle. The pedal force shall be applied and measured according to Appendix A, Figure A2 and Figure A3.
- 4.3.1.8** A visual inspection shall be made at least two (2) times each running day to check for cracks, fractures and functional defects.
- 4.3.2 Noise Measurement Instructions.** A monitoring system with a microphone, according to 3.2.7, shall be used in order to evaluate squeaking and creaking noises in the pedal system and on the booster, continuously during the test.
- 4.3.2.1** The microphone for the pedal noise evaluation should be positioned approximately 0.5 m away from the pedal assembly, measured from the pedal-pushrod connection point. The microphone should also be directed towards the pedal-pushrod connection point.
- 4.3.2.2** The microphone for the brake booster noise evaluation should be positioned approximately 0.5 m away from the brake booster center and 45 degrees from both the horizontal and vertical plane. The microphone should also be directed towards the booster center.
- 4.3.2.3** Attach the calibrator to the microphone and initiate the calibration signal. Activate the data acquisition system and calibrate the microphone using the calibration signal.
- 4.3.2.4** Prepare the noise and test data acquisition system to record the microphone signal and other channels specified for a duration of 5 s. Set up the recording device to initiate the recording 1 s prior to the sound level trigger being reached (e.g., 1 s pre-trigger). If two (2) separate acquisition systems are utilized, the systems do not need to be synchronized. Create a file naming convention such that each file is consecutively numbered so that the sound results can be sequenced properly at the end of the test.
- 4.3.2.5** Set the minimum sound pressure triggering level on the system to record noise data. Refer to requirements for respective system to establish trigger value, at least 5 dBA below the maximum allowed sound pressure level. If no requirements are set, a sound pressure level of 65 dBA shall be set as triggering value.
- 4.3.2.6** Photographs of the setup are shown in Appendix A, Figures A4 and A5.

5 Data

5.1 Calculations. Noise Performance.

5.1.1 Apply a 75 Hz high pass filter to each data set.

5.1.2 For each sound event, calculate the A-weighted sound pressure level and Zwicker loudness time histories of the noise event. Refer to GMW14155 for additional information regarding data processing parameters.

5.2 Interpretation of Results.

5.2.1 Functionality Inspection. Check for cracks, fractures and functional defects in the pedal system at 300 000 cycles or at specified number of cycles according to SSTS/CTS. Reference GMW14048. All observations, according to instructions in 4.3, shall be documented.

5.2.2 Noise Analysis. Create a table of the maximum sound pressure level and loudness achieved during each of the recorded sound events.

5.3 Test Documentation. Document all issues found during the inspection, as well as photos of the test setup and the parts that were part of the test. Publish results in an engineering report stored in the Global Document Management (GDM) system.

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