



Objective Brake Component Squeak and Rattle 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 test is to objectively evaluate brake caliper assemblies (including pads and hardware), drum brake assemblies, multi piece brake rotors and splash shields for squeak and rattle. This test subjects the brake components to test profiles similar to in-vehicle vibrations and then quantifies the squeak and rattle performance.

1.2 Applicability. This procedure is applicable to all passenger car and light truck front and rear brake components.

1.3 Remarks. As noted in GMW14011, this test procedure is primarily focused towards vibration-induced noises excited by inputs above 8 Hz. Furthermore, this test procedure does not comprehend those noises associated with low-frequency vehicle motion or more complex, multi axis vibration profiles.

For brake calipers, refer to GMW15392 Brake Corner Assembly Technical Specification (BCATS), for drum brakes, refer to GMW15391 Rear Drum Brake Corner Assembly Technical Specification or the applicable Subsystem Technical Specifications/Component Technical Specifications (STS/CTS) for the vibration test criteria and objective Squeak and Rattle (S&R) Instationary Loudness criteria.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14011	GMW14925	GMW15392	GMW15981
GMW14188	GMW15391	GMW15443	

2.3 Additional References.

Component Technical Specification (CTS)

Subsystem Technical Specification (STS)

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 Vibration. Information wholly contained within GMW14011.

3.1.4 Noise. Information wholly contained within GMW14011.

3.2 Equipment. GMW14011 lists and describes the required equipment except for the additional items and/or modifications noted in 3.2.1 through 3.2.3.

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 1 of 11

3.2.1 Shaker. GMW14011 lists and describes the required shaker equipment. Since lateral and fore-aft measurements are often tested, a shaker system capable of horizontal excitation is required. An example of a brake high excitation Power Spectral Density (PSD) test table as used for the shaker operation is shown in Appendix A, Figure A4.

3.2.2 Fixture. GMW14011 lists and describes the guidelines for proper fixture design. In addition to these guidelines, the fixture should accurately position the brake component in order to replicate the component orientation in a static vehicle. Furthermore, a caliper fixture should include a simulated rotor section that allows for caliper actuation at various pressure levels. For drum brake testing, the sample should include a brake drum or similar fixture that allows for brake actuation at various pressure levels. An example test fixture with test article is shown in Appendix A: Figures A1, A2 and A3 (calipers), A5 and A6 (drum brakes), A7 and A8 (rotors), A9, A10, A11 and A12 (splash shields).

3.2.3 Apply System. An apply system is required that can provide static hydraulic brake pressure to the brake assembly ranging from 0 kPa to 5000 kPa. The system should also include a pressure measuring or monitoring system in order to determine the hydraulic pressure supplied to the brake assembly. An example apply system is shown in Appendix A, Figures A3.

3.3 Test Vehicle/Test Piece. The brake component should be of the latest revision level available and include all applicable hardware (brake hose, pads, abutment clips, springs, lining assemblies, hold down springs, fasteners, etc.) Samples should include new brake assemblies, with-use brake assemblies, and post durability test brake assemblies that include with-use pads. With-use pads can be conditioned by machining the pads to a half-thickness plus 1 mm wear condition and completing a full GMW14925 inertia dynamometer test. Applicable durability tests include GMW15981 for full size Sport Utility Vehicles (SUV) and Pickup Trucks, GMW15443 for passenger cars and/or a general purpose vehicle durability test. Durability posttest parts include brake assemblies that have been subjected to GMW15981 for full size SUV and Pickup Trucks, GMW15443 for passenger cars and/or a general purpose vehicle durability test. The durability posttest brake assemblies can also be generated using GMW14188, but this should be agreed upon with the responsible engineer prior to any testing. The durability posttest parts should also be tested while equipped with with-use pads, if the posttest pads have more than half of the puck thickness remaining.

3.4 Test Time.

Calendar time:	1 day to 3 days
Test hours:	1 hour per sample
Coordination hours:	1 hour to 8 hours

3.5 Test Required Information. The component math data should be provided to the Test Engineer, showing the brake component in vehicle position so that an appropriate test fixture can be manufactured for testing purposes.

3.6 Personnel/Skills. Information wholly contained within GMW14011.

4 Procedure

4.1 Preparation. GMW14011 lists and describes the required preparation except for the additional items and/or modifications noted in 4.1.1.

4.1.1 Fixture and Test Specimen Mounting. The brake component should be mounted to the fixture at the in-vehicle position/orientation with design intent fasteners set to design intent installation torques and all other applicable hardware. The brake hydraulic apply system should be connected to the brake assembly using the design intent brake hose and a sufficient length of brake line such that the apply system is isolated from the test fixture, brake assembly and shaker. Care should be taken to ensure that the brake hose and brake line are free to deflect during the test, do not contact the shaker or brake assembly, and do not impart a force or moment on the brake assembly that would not be representative of those experienced when mounted in the vehicle.

4.2 Conditions. GMW14011 lists and describes the required conditions except for the additional items and/or modifications noted in 4.2.1 through 4.2.2.

4.2.1 Environmental Conditions. Not applicable.

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 2 of 11



Documents

Document Sharing Hub

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.

Typically, the brake component will be tested to a medium excitation profile, and two high excitation profiles. Refer to GMW15392 Brake Corner Assembly Technical Specification (BCATS), GMW15391 Rear Drum Brake Corner Assembly Technical Specification or the applicable SSTS/CTS.

4.2.2.1 Test samples should include new brake assemblies, with-use brake assemblies, and durability posttest brake assemblies that include with-use pads.

4.3 Instructions. GMW14011 lists and describes the test instructions except for the additional items and/or modifications noted in 4.3.1 through 4.3.2.

4.3.1 Random Test. After bleeding of the brake, the caliper assembly under test shall have the pistons pushed to the bottom and the pads retracted off from the rotor segment. Parking brake calipers with internal park brake mechanism shall have the mechanism set to the nominal design running clearance as expected on the vehicle. Motor On Calipers (MOC) may require an extra operation for proper spindle to nut clearance before starting a test. This operation could include removing the motor assembly, manually setting the nominal design clearance with an Allen wrench and then installing the motor assembly back onto the caliper housing without turning the piston assembly. For drum brake assemblies, the cage setting should be adjusted to provide a nominal design drum to lining clearance prior to the test. Loudness measurements for drum brakes should also be performed, with a cage setting at the larger end of the drum to lining tolerance, to evaluate the rattle performance in this condition.

Start the random controller and allow the controller to ramp up and stabilize to the required test profile. After the test profile stabilizes, allow the test article to be subjected to the test profile for at least 1 minute before performing any measurements.

4.3.1.1 Prepare the microphone location as specified in Appendix A, Figure A3. The microphone is to be positioned 15 cm radially outward from the center of the test specimen with the brake component positioned in its static vehicle orientation. Each day prior to performing a test, record the background noise of the test chamber with the shaker at rest and compare to GMW14011 requirements.

4.3.1.2 Apply 500 kPa hydraulic brake pressure to the brake component and hold the pressure. Subject the test component to the test profile and perform the loudness measurements for 30 s. Release the hydraulic brake pressure, subject the brake assembly to the test profile and repeat the loudness measurements. Repeat this sequence two additional times to complete the 500 kPa testing. Repeat these steps for a hydraulic brake pressure of 5000 kPa. See Table 1 for a tabular outline of the test sequence. The Table 1 outline should be repeated for each random test profile (example: medium excitation Number 1, high excitation Number 1, high excitation Number 2, etc.) For brake components that do not use hydraulic pressure and for drum brake investigations without the drum installed, the format outlined in Table 1 can be followed without hydraulic pressure applies.

4.3.1.3 If the measured Zwicker loudness exceeds the performance requirement, identify each individual squeak and rattle (i.e., caliper pin-to-bore contact, pad-to-abutment contact, drum brake shoe and lining contact, rotor disc to rotor hat contact, splash shield to knuckle contact, etc.) Proceed with the development of corrective actions for each squeak and rattle.

4.3.1.4 The measurement parameters outlined in GMW14011 should be used for the recording of the product noise, but a minimum of 30 s of sound data shall be recorded for subsequent analysis.

4.3.2 Swept Sine Test. A swept sine test should only be used for diagnosing product noise sources and for comparative purposes. A swept sine test from approximately 8 Hz to 100 Hz can be especially useful for root sourcing a squeak or rattle, or making comparative loudness measurements between-brake assemblies. It is required that noises be noted first using shaped random input. Once noted, the swept sine can be used for analysis, and any swept sine test level that excites the noise concern is adequate.

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 3 of 11



Documents

Document Sharing Hub

**Table 1: General Instructions for Brake Caliper and Drum Brake
Random Control Squeak and Rattle Testing**

1	Brake Preparation:	Push in the caliper pistons and retract pads from rotor. For drum brakes, set cage to required drum to lining clearance.
2	500 kPa Brake Pressure Hold:	Increase hydraulic brake pressure to 500 kPa and hold.
3	Random Control:	Start random test profile and wait at least 1 minute prior to any loudness measurements.
4	Loudness Measurements With Brake Pressure:	Verify microphone is 15 cm radially from brake component and perform the loudness measurements for 30 s. Pause the test profile.
5	Release Brake Pressure:	Release the hydraulic brake pressure to 0 kPa.
6	Random Control:	Restart the test profile.
7	Loudness Measurements Without Brake Pressure:	Perform the loudness measurements for 30 s then pause the profile.
8	Additional Measurements:	Repeat 2 through 7, two (2) more times. This will provide three (3) recordings with pressure held and three (3) recordings without pressure.
9	5000 kPa Measurements:	Repeat 2 through 8 with 5000 kPa brake pressure.
10	Additional Test Profile Measurements:	Change the random test profile as necessary and rerun the testing table Steps 2 through 9.

5 Data

5.1 Calculations. GMW14011 lists and describes the data calculations instructions and analyses parameters.

5.2 Interpretation of Results.

5.2.1 The measured N10 Zwicker Loudness (based on 90th percentile) at any measured location must not exceed the N10 Zwicker Loudness requirement specified in GMW15392 (BCATS) or the applicable SSTs/CTS.

5.2.2. Complete the data reporting sections of the forms in GMW14011.

5.3 Test Documentation. The test information and results should be documented and published as specified in GMW14011 using the GM Evaluation Report template and Global Document Management system or its successor. The summarized loudness measurements and electronic audio files (*.data) shall be made available to GM Engineering upon request. This includes all GM project testing as requested internally by the test facility, by any supplier, or by GM Engineering.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary. Information wholly contained within GMW14011.

7.2 Acronyms, Abbreviations, and Symbols.

BCATS	Brake Corner Assembly Technical Specification
CTS	Component Technical Specification
GSSLT	Global Subsystem Leadership Team

GM Confidential

© Copyright 2014 General Motors Company All Rights Reserved

December 2014

Page 4 of 11