



Subjective Subsystem/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. To perform subjective component and subsystem level validation for squeak and rattle noises when subjected to a vibration spectrum comparable to “in vehicle” vibration.

1.2 Applicability. This procedure is applicable to any automotive component or subsystem where squeaks and rattles are a concern and the vibration environment can be simulated.

1.3 Remarks. This test is limited to detecting vibration induced noises, excited by inputs > 8 Hz. Squeaks or itches excited only by slow body twist (cross ditches or driveways) will not be addressed by this test. Additionally, impact type vibrations caused by a door, hood or rear compartment lid slam cannot be addressed by this test.

Refer to the Squeak and Rattle (S&R) SSTS/CTS for the vibration test criteria and subjective evaluation criteria.

This procedure is used for **Subjective** evaluation when conducting the subsystem/component degradation test referenced in GMW14188. For the **Objective** S&R evaluation refer to GMW14011.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW7294

GMW8518

GMW14188

GMW14264

GMW7880

2.3 Additional References.

- Component Technical Specification (CTS), S&R specific
- MB Dynamics equipment, available from www.mbdynamics.com/Vibration-Solutions.php.
- Subsystem Technical Specification (SSTS), S&R specific

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 The facility must be free of:

- Any vibrations, which may affect the test specimen. Facility vibration levels should not exceed 5% of the test specified input vibration level, at any frequency.
- Noise which may limit the detection or evaluation of squeaks or rattles.

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3.1.4 When the S&R SSTS/CTS calls for hot or cold temperature conditions, a walk-in environmental room or chamber is required. Recommended temperature range capability for the room or chamber is +50 °C to -30 °C. The background noise in the chamber or room must be sufficiently low as to not inhibit or mask subjective evaluation of any product noise. It is acceptable to perform subjective evaluations between the Chamber Ventilation/Environmental system cycles, providing there is adequate time between cycles.

3.2 Equipment.

3.2.1 Shaker. A quiet shaker or actuator capable of replicating the specified vibration spectrum into the component or subsystem is required. Dynamic stroke should be at least 2.5 cm in order to meet the vibration profile requirements. The shaker must be sufficiently quiet so as not to mask any squeaks and/or rattles. A larger shaker or hydraulic actuator may be required for larger subsystems such as instrument panels, doors and seats. Larger shakers and hydraulic actuators are usually noisier and may require an acoustic cover or treatment.

Recommend: MB Dynamics Energizer Series Shakers, available from www.mbdynamics.com/Vibration-Solutions.php.

3.2.2 Fixture. Fixtures should be rigid, free of resonances in the 0 Hz to 200 Hz range and free from rattles, creaks and other potentially conflicting noises. Fixture resonances, when excited, can contribute to background noise levels, alter the vibration input to the component, and potentially make test control very difficult. To avoid using up the travel and dynamic capability of the shaker, the fixture should also be as light as possible. Magnesium is the material of choice because of its low mass, high degree of stiffness and damping characteristics. Aluminum is often an acceptable substitute.

If noise measurements are being made on larger subsystems, airbag supports may be used to support the static weight of the component and fixture. A smaller and quieter electromagnetic shaker may then be used to provide the dynamic force to the subsystem.

Recommend: MB Dynamics Universal Test Fixture for testing instrument panel(s) (IP), doors, seats and other large subsystems, see 2.3.

3.2.3 Random Controller. A digital random controller that provides the control signal with random and swept sine control capability is required. It is recommended that a controller with shock and time replication available be selected. The controller must be capable of controlling the shaker:

- In the 5 Hz to 400 Hz range with a minimum of 1 Hz frequency resolution.
- With closed loop control.
- Selectable N-Sigma clipping units or crest factor.

3.2.4 Accelerometer and Signal Conditioner. An accelerometer and appropriate signal conditioning are required to monitor acceleration input to the test specimen. If a strain-gage type accelerometer is used, its nominal acceleration range shall not exceed five (5) times the amplitude of maximum specified input acceleration. The accelerometer must not have a resonant frequency less than two (2) times the highest specified test frequency (normally 200 Hz).

Recommend: Low mass Integrated Circuit-Piezoelectric (ICP) type accelerometer with a minimum sensitivity of 100 mV/(m/s²).

3.2.5 Environmental Equipment. When extreme cold temperature testing is being performed in a walk in test cell, protective clothing must be used for the safety and comfort of the test personnel.

3.3 Test Vehicle/Test Piece.

3.3.1 Test Vehicle. No test vehicle is used for the laboratory vibration test in this procedure. However, the input data for the test is obtained from "in vehicle" acceleration measurements at the component or subsystem attachment locations. This data shall be taken according to GMW7880. Input data for this test shall be obtained from the product specification for the vehicle line of interest. For the most part, data is obtained from "in vehicle" measurements made on the proving ground test road system. However, in some cases, data may be obtained from a vehicle on a four-post road simulator.

3.3.2 Test Piece. Test components/subsystems should be of the latest revision level available. Full documentation shall be provided with the material including: supplier, part number, vintage, i.e., Integration Vehicle Engineering Release (IVER), Manufacturing Validation (ManVal), etc., change level and a description of any unique features.

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Documents

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3.4 Test Time.

Calendar time: 1 to 3 days
Test time: 1 to 8 hours
Coordination time: 2 to 8 hours

3.5 Test Required Information.

 Not applicable.

3.6 Personnel/Skills.

3.6.1 A skilled Technician or an Engineer can perform this test procedure. Test personnel shall have a working knowledge of:

3.6.1.1 Specific shaker or actuator being used and its amplifier or controller.

3.6.1.2 Specific Digital Random Controller being used.

3.6.1.3 Accelerometers (selection, mounting and calibration).

3.6.1.4 Fixturing for vibration testing.

3.6.1.5 S&R root source analysis.

3.6.1.6 A general knowledge of the product being tested.

3.6.2 Hearing Requirements. Auditors for S&R testing must have an audiological test performed on both ears, as required by the Global region requesting the test.

4 Procedure

4.1 Preparation.

4.1.1 All components, subsystems and systems should be mounted in vehicle position with design intent fasteners and hardware. Careful attention shall be paid to installation torques, harness, belt and cable routing and clearances and adjustments. If the components/subsystems have adjustment capability, each reasonable position should be evaluated. Suppliers are responsible for having their parts S&R-free in all possible positions. The sample must be mounted such that the shaker will not bottom out or hit any internal stops, which may induce an impact to the test specimen or create unwanted noise. The shaker should also be attached at the center of gravity of the fixtured part, so as not to introduce any rotational motions (overturning moments) into the test specimen or induce side loading or moments on the shaker. The mass center and static loading are less critical with a hydraulic actuator. The shaker or actuator should be mounted to a reaction mass or bedplate of sufficient size as to avoid generating noise in the building, floor and or other supporting structure. An accelerometer shall be mounted on the test specimen at the attachment to the fixture or on the fixture at a point judged to have a vibration level comparable to the input level of the part.

4.1.2 The Random Controller shall be set up with the random profile specified in the SSTS/CTS and the appropriate meter per second squared (m/s^2) Root Mean Square (RMS) level. N-Sigma clipping should be set for three (3) unless otherwise stated. A swept sine test should only be used for diagnosing product noise. The swept sine can be especially useful for root cause analysis of a squeak or rattle. It is required that noises be noted using shaped random input. Once noted the swept sine can be used for analysis. Any swept sine test level which excites the noise of concern is adequate. There is no S&R product requirement for sinusoidal inputs.

4.2 Conditions. The subsystem or component shall be tested in the directions specified in the SSTS/CTS with the subsystem or component mounted in body position. Due to potential preloading of components by gravity, fore-aft and lateral tests should not be conducted by rotating the test part out of vehicle-intent position. If specified, the fore-aft and lateral tests can be performed with:

- Multi-axis shaker
- Suspended from soft springs (be sure that mounted resonant frequency is outside the frequency range being tested)
- On a table set up with linkages or flexures

No matter what type of device is used, the background noise must be sufficiently low as to not inhibit or mask subjective evaluation of any product noise.

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