



Squeak and Rattle Degradation Test for Passenger Cars and Light Trucks

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 deterioration of vehicle Squeak and Rattle (S&R) performance relative to vehicle mileage accumulation.

1.2 Applicability. For all passenger cars and light trucks.

1.3 Remarks. In order to produce accelerated vehicle deterioration or wear, there are various methods and strategies that can be employed. Regional engineering centers and/or proving grounds may use specific road courses to perform S&R-specific degradation. Some regional examples of road based degradation are detailed in Appendices A and B.

In addition, a road simulation is described.

The road simulation sequence in this procedure is based on North American roads. The first 80 h of testing represent 40% of the GM North America (GMNA) expected customer usage, relative to vibration input, or the equivalent of 60 000 km. The road simulator methodology also includes two (2) cycles of hot environment, with solar simulation, to address potential degradation of polymeric materials, primarily in the Instrument Panel (IP) area.

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

2.3 Additional References. None.

3 Resources

3.1 Facilities. A four-post road simulator within an acoustic enclosure suitable for S&R evaluations is required for this procedure. The road simulator must be "man rated," meaning the loads produced by the actuators through the vehicle's suspension must not exceed safety standards for an occupant within the vehicle's passenger compartment.

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 Tire coupled road simulator.

3.2.2 A solar simulator capable of producing full spectrum solar energy at a level of 1000 watts/m² over the surface area of the windshield and upper instrument panel.

3.2.3 A pyranometer to measure solar energy at the windshield surface.

3.2.4 Thermocouples and readout to monitor shock/strut temperatures and shut down test if shock temperature exceeds 105 °C.

3.2.5 Cooling fans or compressed air nozzles capable of maintaining shock absorbers temperatures < 105 °C.

3.3 Test Vehicle/Test Piece. Vehicle equipped per program requirements.

3.4 Test Time.

Calendar time: 10 days

Test time: 80 hours

Coordination time: 1 hour

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. A skilled driver for the road test or a trained evaluator for the simulator test is required.

4 Procedure

4.1 Preparation.

4.1.1 Shock/Strut Thermocouples for Road Simulator. Attach thermocouples to each shock absorber or strut to allow temperature monitoring during the degradation testing. Thermocouples should typically be attached on the inboard side of the shocks or struts, or otherwise away from the direct flow of cooling air.

4.1.2 Instrument Panel Thermocouples for Road Simulator. Instrument the IP with thermocouples, mounting a minimum of three (3) thermocouples on the upper pad (left, center and right side), and two (2) thermocouples lower in the instrument panel, by the glove box, radio head, HVAC control head, cluster or other easily accessible areas, within the interior of the IP.

4.2 Conditions.

4.2.1 Environmental Conditions. Test must include two (2) cycles of hot environment, with solar simulation.

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 Vehicle Ballast. Vehicle is to be run without ballast.

4.2.2.2 Road Simulation Profiles and Shares (based on GMNA Milford Proving Ground road surfaces). See Table 1.

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Table 1: Road Simulation Profiles and Shares

Road Surface	Speed (km/h)	Time (Minute)
Truck loop right lane second section	30	1
Spalled concrete	40	1
Spalled concrete	70	1
Noise road	30	0.5
Oval track third lane (impact bumps)	90	1
Belgian blocks	40	0.5
Total	--	5

Note: km/h = kilometers per hour.

4.3 Instructions.

4.3.1 Checks, Measurements and Evaluations to be Performed.

4.3.1.1 Perform a full vehicle evaluation per GMW8518 at the start of the test. A full vehicle Squeak and Rattle Index (SRI) can be determined per GMW7294 under ambient conditions at a point equivalent to 4500 km to 6500 km (6 h to 8 h).

4.3.1.2 If excessive noise is produced by the shock cooling system, the shock coolers per 4.3.3.2 may be temporarily disabled during the evaluation only, but shock/strut temperatures should be monitored and maintained < 105 °C or the shutdown feature, using thermocouples, should be actively engaged.

4.3.1.3 Repeat the full vehicle evaluation at 50% of test or after the 40th hour, per GMW8518, at the ambient environmental condition only.

4.3.1.4 Repeat the full vehicle evaluation at 100% of test or after the 80th hour, per GMW8518, under the environmental conditions specified. An SRI can be determined per GMW7294.

4.3.2 Environmental Degradation.

4.3.2.1 Two (2) cycles are required. Perform the first cycle prior to the 6th hour and the second at 50% of the test (40 h). It is suggested that the road simulator be operated while the vehicle is being brought to temperature, soaked and then returned to ambient temperature.

4.3.2.2 Bring the entire vehicle up to 50 °C in an environmental chamber, as quickly as the chamber will allow.

4.3.2.3 Simultaneously, using a solar simulator, expose the instrument panel to solar radiation. The solar energy should be set up for an angle of incidence of 30 degrees from vertical. The solar energy level shall be set up to obtain a uniform energy distribution of 940 watts/m² over as much of the windshield area as possible using the pyranometer.

4.3.2.4 Maintain the chamber temperature and solar exposure until the instrument panel temperatures have stabilized. Then hold one (1) additional hour.

4.3.2.5 Return vehicle and instrument panel to ambient temperature as quickly as possible.

4.3.2.6 Repeat 4.3.2.2 through 4.3.2.5 one (1) time.

4.3.3 Conducting the Road Simulator Degradation.

4.3.3.1 Shock absorber temperature shall also be monitored throughout the duration of testing using a thermocouple. Using a four-post road simulator, expose the vehicle to vibration degradation by playing the 5 minute degradation sequence file specified in Table 1.

4.3.3.2 During the vibration portion of the test, supplemental shock absorber cooling shall be provided.

4.3.3.3 Shock absorber temperatures are not to exceed 105 °C.

4.3.3.4 Maintain a log of elapsed test time.

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4.3.3.5 Continue running the degradation sequence until it is time for a vehicle evaluation (as specified in 4.3.1). Note the test time and/or number of cycles completed, then perform the vehicle evaluation and resume degradation from the point where it was interrupted.

4.3.4 Final Vehicle Inspection.

4.3.4.1 The vehicle is to be torn down to inspect for wear marks in those areas deemed appropriate by the test engineer.

4.3.4.2 All findings are to be documented per GMW8518. Use photographs and/or video recordings where necessary.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. Test issues can be recorded on an evaluation form. A sample is found in GMW8518, Appendix F. Problem Resolution and Tracking System (PRTS) should be written for any issues that do not meet program requirements.

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.

In general, a risk assessment needs to be performed for every driving instruction prior to executing this standard. (**Note:** National law needs to be considered while performing a risk assessment.) The required rating of risk by exposure probability and possible violation will be done in a separate document. Every identified risk must be named inside the risk assessment for the relevant driving instruction in order to announce that risk to employees. Within the risk assessment, the vehicle equipment and different vehicle build stages have to be considered. After performing a risk assessment, non-acceptable risk needs to be mitigated by appropriate countermeasures. Here technical measures are preferred because these are independent from attendant circumstances. In case technical measures are not appropriate, organizational and/or personal measures will apply. This includes training, wearing of Personal Protection Equipment, or arrangement of idle time.

6.1 Safety Precautions.

6.1.1 Instrumentation and other test equipment must be securely mounted in accordance with proving grounds traffic safety guidelines for mounting and usage of in-vehicle instrumentation.

6.1.2 All running lights and vehicle safety features must be operational according to proving grounds rules for running lights and power windows. Exterior lights must not be obscured by styling add-ons, covers or camouflage packages. The horn may be disabled because of steer angle transducer installation.

6.1.3 A helmet is required in accordance with the regulations of the test facility. The vehicle should never be operated in a manner where the vehicle leaves the roadway or goes onto the shoulder for any reason.

6.1.4 Check for proper attachment of the steering wheel to the gear via the intermediate shaft. If it feels loose or abnormal, do not run the test until the parts are properly assembled according to the intended design.

6.1.5 Check to be certain that all wheel lugs are present and have the specified torque. Loose or missing wheel fasteners are to be replaced, installed or tightened before the test may begin.

6.1.6 The driver's seatbelt must be worn at all times during the test. Passengers accompanying the test operator must also be safely belted in the vehicle, preferably in the right rear seat.

Note: Passengers are allowed for observation or training purposes.

6.1.7 If a crossbar is used to hold the steering wheel angle transducer base plate, the passenger side airbag is to be disabled or disconnected.

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