



Noise and Vibration Subjective Evaluation Procedure

1 Scope

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 procedure is to provide a common subjective procedure for certain types of noise and vibration (N&V) subjective evaluations.

1.2 Foreword. This procedure has been established to promote compatibility within the GM organization. It is to be used for the purpose of subjective noise and vibration performance assessment.

1.3 Applicability. This procedure is intended for: passenger cars, light trucks, multipurpose passenger vehicles, minibuses, and light commercial vehicles with a maximum total weight of up to 3500 kg.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14264

2.3 Additional References.

GM Research and Development (R&D)
Report AS-598, "Hearing Acuity Standard for Squeak and Rattle Evaluators"

3 Resources

3.1 Facilities. The tests shall be performed on the designated test roads at each GM regional site or approved public roads. Test site must be free of obstacles that could reflect sound. Test site must be free of non-vehicle induced noise that can influence the results.

3.2 Equipment. A copy of the noise and vibration subjective evaluation form and a copy of

GMW14264 (Subjective Rating Scale). See Appendix A for scoring sheets.

3.3 Test Vehicle/Test Piece. The test vehicle's build condition and installed content should be production, or alternatively, should be investigated, known and documented.

3.4 Test Time.

Calendar time: 0.5 to 1 day

Test hours: 4 to 8 hours

Coordination hours: 2 to 4 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. One person for driver's seat evaluations or two people for rear seat in-motion evaluations. This person should be qualified or trained in performing N&V evaluations. This person must follow all regional/local regulations for use of test roads.

3.6.1 Auditor Skill Level. Novice evaluators shall have completed three prior full vehicle subjective noise evaluations under the direct supervision of an experienced N&V evaluator.

3.6.2 Hearing Requirements. It is recommended that all evaluators for noise evaluations have a hearing test performed and be aware of their limitations. Any professional hearing test is acceptable, but the following test is given as a reference: GM R&D Report AS-598, "Hearing Acuity Standard for Squeak and Rattle Evaluators".

4 Procedure

4.1 Preparation. Apply the following vehicle criteria unless an evaluation in 4.3 specifically states to alter it.

4.1.1 Standardize the Vehicle Condition. Wash the vehicle. Ensure fuel tank is at least $\frac{3}{4}$ full to prevent fuel sloshing. Configure non-driver seating positions to a normal state of mid-travel fore/aft and mid-height vertically (instructions in Appendix B). Verify stowed accessories are secured per production intent (jacks, spare tires, tools, etc.) Adjust tire pressures to nominal (cold) values as stated by the vehicle manufacturer. Run engine until operating temperature is reached. Switch off the air conditioning at least ten minutes

before the start of the test (to avoid cycling, pressure dissipation hiss, and increased noise transmission due to cold and stiff hoses).

4.1.2 Configure the Vehicle for a Quiet Interior.

Verify that all body closures, windows, sunroof, sunshades, rear seat pass-throughs, and interior compartments are closed. Set the heating ventilation and air conditioning (HVAC) system to off or floor vents. Set the HVAC system fan to off (or the lowest speed possible). Set the HVAC system air intake to recirculate. Configure all adjustable HVAC vents to be open and pointing straight (not skewed up/down, left/right). Confirm radio/entertainment system is off.

4.1.3 Configure the Vehicle for a Quiet Exterior.

Remove interior and exterior camouflage to prevent unintentional noise influences. Verify luggage rack cross members are in their recommended "low noise" positions per the vehicle owners manual.

4.1.4 Address Any Extraneous Noises.

Eliminate, reduce, or ignore sounds not directly associated with the area, component or system being tested (e.g., eliminate rattles or other distracting sounds not related to what is being tested).

4.2 Conditions.

4.2.1 Environmental Conditions. Weather conditions must be such that they will not influence the results of the evaluation. Due to the varied types of evaluations in this document, the operator must use proper judgment to what can be done in any given circumstance (e.g., scores on idle vibrations usually are not influenced by wind conditions).

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.

4.3 Instructions. Evaluate the vehicle for the conditions that follow, and evaluate to GMW14264 (Subjective Rating Scale) for the stated attributes. Appendix A contains the scoring form. Perform stationary evaluations in a hemi-anechoic "quiet" room. Apply foot brake for idle in gear (automatic transmissions), and for idle in neutral (manual transmissions). "Accessories" include high power draw items such as headlights and rear defoggers to task the alternator.

4.3.1 Powertrain N&V - Idle N&V. Operating conditions evaluated:

- In drive, accessories off.
- In drive, accessories on.

c. In neutral, accessories off.

d. (Manual transmissions only) In neutral, Accessories on.

4.3.1.1 Idle Noise, Interior Attributes. Evaluate the **overall loudness level** for being appropriate. Evaluate the overall **sound quality** for the presence of pleasing attributes, and the lack of displeasing ones. Evaluate the level of **"boom"** for being appropriate.

4.3.1.2 Idle Noise, Exterior Attributes. Evaluate the **overall loudness level** for being appropriate. Evaluate the overall **sound quality** for the presence of pleasing attributes, and the lack of displeasing ones. Evaluate the level of **"boom"** for being appropriate.

4.3.1.3 Idle Vibration Attributes. Evaluate the vibration experienced in the **steering wheel** for being appropriate. Evaluate the vibration experienced in the **seat cushion** for being appropriate.

4.3.2 Powertrain N&V - Drive away Noise. Operating conditions evaluated:

- Nominal driving acceleration.
- Wide open throttle acceleration.
- Coast down.

4.3.2.1 Drive away Noise Attributes. Evaluate the overall loudness level for being appropriate. Evaluate the overall sound quality and character for the presence of pleasing attributes, and the lack of displeasing ones. Evaluate the level of "boom" for being appropriate. Evaluate the audible linearity of the event for being appropriate.

4.3.3 Powertrain N&V - Cruising N&V. Operating conditions evaluated:

- High gear, low speed sweep.
- High gear, coast down.
- High gear, wide open throttle sweep.
- Smooth road, low, moderate, and high speeds.

4.3.3.1 Cruising Noise Attributes. Evaluate the **overall loudness level** for being appropriate. Evaluate the overall **sound quality and character** for the presence of pleasing attributes, and the lack of displeasing ones. Evaluate the level of **"boom"** for being appropriate. Evaluate the audible **linearity** of the event for being appropriate.

4.3.3.2 Cruising Vibration Attributes. Evaluate the vibration experienced in the **steering wheel** for being appropriate. Evaluate the vibration experienced in the **seat cushion** for being appropriate.