



On Road Partial Pressure Contribution and Spindle Sensitivity Evaluation Procedure

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.

The Road Noise Evaluation Procedure, GMW8460, and Transducer Calibration Verification Master Test Procedure, GMW14172, shall be referenced for more detailed information for the following procedure.

1.1 Purpose. Determine the vehicle road noise sensitivity behavior independent of the road and tire influences and estimate contribution from rear and front axles or from each corner.

1.2 Applicability. Passenger cars, multi-purpose passenger vehicles, minibuses and light commercial vehicles with a maximum authorized total weight of 3500 kg.

1.3 Remarks. This procedure is used to assess the performance of GM and competitive vehicles under any road excitation (usually on coarse or stud damaged concrete (SDC) roads) and can be easily executed in conjunction with the Road Noise Evaluation Procedure, GMW8460.

2 References

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

2.1 External Standards/Specifications.

IEC 651

2.2 GM Standards/Specifications.

GMW8460 GMW14172

2.3 Additional References. None.

3 Resources

3.1 Facilities. The tests shall be performed on the GM global noise coarse road surface in the designated testing environment at each GM regional site, see GMW8460.

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.

3.2 Equipment. Random incidence microphones, accelerometers and a 24 bit analog-to-digital converter are required for testing. However, free-field microphones may be used.

3.2.1 Microphones. See GMW8460.

3.2.2 Accelerometers. High sensitivity accelerometers with a flat frequency response between 2 Hz to 2 kHz and a temperature range between 10 °C to 50 °C may be used.

3.2.3 Data Acquisition Equipment. Multichannel data acquisition hardware capable of calculating frequency domain results between 0 Hz and 20 kHz, and have a minimum of 80 dB dynamic range. This hardware shall meet Class 1 accuracy corresponding to IEC 651 or be equivalent for the application (precision ± 0.7 dB or $\pm 8\%$). See GMW8460.

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3.3 Test Vehicle/Test Piece. See GMW8460.

3.4 Test Time.

Calendar time: 1 day

Test time: 5 hours

Coordination time: 2 hours

3.5 Test Required Information. See GMW8460.

3.6 Personnel/Skills. One (1) qualified engineer or technician trained in the use of data acquisition and recording equipment and having basic knowledge of acoustic and vibration signal processing.

4 Procedure

4.1 Preparation.

4.1.1 Vehicle Preparation. See GMW8460.

4.2 Conditions.

4.2.1 Environmental Conditions. See GMW8460.

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.

4.2.3. Vehicle Conditions. See GMW8460.

4.3 Instructions.

4.3.1 Calibration. Check equipment for valid calibration date. Replace outdated equipment. Turn on all instrumentation 5 minutes prior to calibrating. Calibrate the transducers as specified in GMW14172. Record calibration values and gain settings.

4.3.2 Install Data Acquisition Equipment. See GMW8460 for microphone standard positions.

The acceleration transducers shall be located at each spindle at a rigid position. See Appendix A for examples of accelerometer attachment locations.

4.3.3 Measurements. See GMW8460, for measurement instructions.

4.3.3.1 Low Speed Road Noise. The road test shall primarily be performed on coarse road surfaces (coarse asphalt or SDC) at 60 km/h. It may also be performed on smooth asphalt at 60 km/h if required for root cause or development purposes. See GMW8460 for more details.

5 Data

5.1 Calculations.

5.1.1 Road Noise Narrow Band Spectral Data. Autospectra for the accelerometers and microphones signals shall be calculated. Cross spectra between the accelerometer and the microphones signals shall also be calculated. Spectral data shall be obtained with linear frequency weighting and the following parameters:

- Power function
- Root Mean Square (RMS) format
- Correction factor set to Fixed Energy
- $F_{\max}$ equal to 1024 Hz
- Hanning window with 75% overlap
- Frequency resolution of 1 Hz
- A minimum of 14 s of time data
- Linear Averaging

5.1.2 On Road Partial Pressure Contribution and Spindle Sensitivity. Data shall be processed per equations detailed in Appendix B.

5.2 Interpretation of Results. Analysis examples are given in Appendix C, Figures C1 thru C8.

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5.3 Test Documentation. Narrow band results for spindle sensitivity shall be documented in A-weighted spectra usually displayed between 0 Hz to 600 Hz (at minimum between 0 Hz and 300 Hz) using a decibel (dB) scale (reference 20 $\mu\text{Pa}/1 \text{ m/s}^2$) on a vertical axis.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

CRN	Coarse Road Noise
DOF	Degrees of Freedom
LF	Left Front
LFRE	Left Front Right Ear
LR	Left Rear
MIMO	Multiple Inputs and Multiple Outputs
N&V	Noise and Vibration
RF	Right Front
RMS	Root Mean Square
RR	Right Rear
SDC	Stud Damaged Concrete
VPO	Vehicle Performance Owner

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW15413

9 Release and Revisions

This standard was originated in August 2006. It was first approved by the Noise and Vibration Global Structure-borne Noise Harmonization Team in October 2006. It was first published in October 2006.

Issue	Publication Date	Description (Organization)
1	OCT 2006	Initial publication.
2	JUN 2011	Five year refresh. (Global N&V Structures VPO Team)
3	DEC 2016	Revised to current template. (Global N&V VPO Team – Structure-borne Noise)

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