GM WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW14387

Electrically Powered Component – Sound Power 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. Define the process for quantifying the sound power third-octave spectra of electrically powered components. The product of this procedure will be a series of sound power spectra in dB magnitude (10^{-12} W).

1.2 Foreword. Sound power of an energized component defines the component's source level for airborne noise. This quantity, with others, can be used to predict noise levels in the vehicle passenger compartment.

1.3 Applicability. This test procedure is appropriate to use for electrically powered system actuated and customer actuated components that can be tested free-free without additional mount fixturing, complex line routing, complex electronic controls or complex fluid controls. Example components include, but are not limited to, the following:

1.3.1 Secondary air injection (SAI) pumps.

1.3.2 Air suspension system compressors used for electronic leveling and/or air suspension control.

1.3.3 Brake system electric vacuum pumps.

1.3.4 Fuel system electric vacuum pumps used in evaporative leak check modules (ELCM).

1.3.5 Low temperature coolant pumps used for:

- Heater core cooling.
- Electric rear differential module (RDM) cooling.
- High voltage battery cooling.
- Powertrain electric control module cooling, such as, the transmission power inverter module (TPIM), the electric motor/generator unit (MGU), the starter/generator control module (SGCM) or to the powertrain electronics box (PEB).

2 References

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

2.1 External Standards/Specifications.

IEC 651 ISO 9614-2

ISO 3745

2.2 GM Standards/Specifications.

GMW14172

2.3 Additional References.

None

3 Resources

3.1 Facilities. Anechoic or hemi-anechoic test room (see ISO 3745 or ISO 9614-2).

3.2 Equipment.

3.2.1 Microphone Array. Required for sound power calculation from sound pressure measurements (see ISO 3745).

3.2.2 Intensity Probe. Required for sound power calculation from sound intensity measurements (see ISO 9614-2).

3.2.3 Data Acquisition System. Data acquisition hardware capable of calculating frequency domain results between 22 Hz and 11200 Hz with 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 ± 8%).

3.2.4 Variable DC Power Supply. Variable DC power supply with sufficient capacity to provide at least 15 V at 50 A.

3.3 Test Vehicle/Test Piece. A representative component with cabling including appropriate electrical connection is required. Hardware to restrict air/fluid flow or air shocks with airlines may be required.

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3.4 Test Time.

Calendar time:	1 day
Test hours:	6 hours
Coordination hours:	2 hours

3.5 Test Required Information. Appropriate component operating voltage range.

3.6 Personnel/Skills. To complete this test, at least one technician and/or one engineer skilled in acoustic data acquisition, analysis, equipment use, and test setup is required.

4 Procedure

4.1 Preparation. Using elastomeric cords, suspend the test piece as oriented in the vehicle using the vehicle attachment points to approximate free-free boundary conditions.

Note: Do not overly constrain the test piece. The elastomeric cord stiffness should be as low as possible.

Inlet and outlet air lines of the component must be routed out of the test room, so as not to affect the component noise measurements. Liquid fluid lines should be routed to and from the appropriate fluid supply and may also need to be routed out of the test room, so as not to affect the component noise measurements. Treat lines with acoustic barrier material to reduce noise radiation from the lines as required. Component inlets or outlets that are open in the vehicle should remain open in the test as part of the component source noise measurements.

4.2 Conditions.

4.2.1 Environmental Conditions. See ISO 3745 or ISO 9614-2.

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.

4.3.1 Calibration Verification. Check equipment for valid calibration date. Replace out of date equipment. Perform equipment calibration verification (see GMW14172).

4.3.2 Data Acquisition. Use a six sided reference cube when using the sound intensity method in ISO 9614-2 or use a microphone array when using the sound pressure method in ISO 3745. Operate the component with an external voltage supply at voltages between 9 V and 15 V, or other appropriate voltage range as experienced in vehicle. Use 1 V increments, with minimum of 5 minutes cool down time between measurements or as appropriate for the test component. Acquire appropriate linear sound pressure or sound intensity data in both one-third octave and narrowband spectral formats using the following parameters:

- Acoustic frequency range: 22 V to 11 200 Hz
- Frequency resolution: 1 Hz
- Window: Hanning, Energy Correction
- Amplitude: Rms

Use enough averages to achieve stable amplitude values. Store data as required for acquisition system. Repeat measurements as required for each defined voltage increment.

See ISO 3745 or ISO 9614-2.

5 Data

5.1 Calculations. Process the data to obtain average narrowband linear spectra from 22 Hz to 11 200 Hz and third-octave band data for the 25 Hz to 10 000 Hz third-octave bands. Use the appropriate calculations from IS0 9614-2 or ISO 3745 to obtain the resulting sound power values.

5.2 Interpretation of Results. Compare the sound power spectra to the target levels as specified in the appropriate Subsystem Technical Specification (SSTS) or Component Technical Specification (CTS). The sound power spectra must meet the target levels at all appropriate operating voltages.

5.3 Test Documentation. Standardized formats contained in the appropriate Global SSTS or CTS template shall be used to view data.

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. See ISO 3745 or ISO 9614-2.

7.2 Acronyms, Abbreviations, and Symbols.

CTS	Component Technical Specification
ELCM	Evaporative Leak Check Module

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