GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW17067

Electrically Powered Blowers – Sound Power and Free-Acceleration 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 test procedure defines the process for quantifying the free acceleration and sound power (L_W) ⅓ octave and narrowband spectra of electrically powered blowers for energy storage systems and power electronics thermal management. The product of this procedure will be: a series of sound power spectra in decibel magnitude (reference: 10^{-12}W (A-weighted)), acceleration, input power, voltage and current (all are a function of blower flow rates).

1.2 Foreword. Sound power of an energized component defines the component's source level for airborne noise.

Note: The airborne sound power can be changed by the mounting of the component in the vehicle. Sound power, along with other parameters, will be used to predict noise levels in the vehicle passenger compartment and outside the vehicle.

1.3 Applicability. This test procedure is appropriate for electrically powered system actuated blowers that can be tested free-free, with and without complex electronic controls, with a defined flow load or resistance.

1.3.1 Blowers are used for, but not limited to:

- High-voltage battery cooling or heating
- Electric control modules and components cooling or heating

2 References

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

2.1 External Standards/Specifications.

IEC 651	ISO 3744	ISO 3745	ISO 9614-2

2.2 GM Standards/Specifications.

GMW14172	GMW14227	GMW14386

2.3 Additional References.

- Component Technical Specifications (CTS)
- Subsystem Technical Specifications (SSTS)

3 Resources

3.1 Facilities. Use a hemi-anechoic test room (reference ISO 3744 or ISO 9614-2). The room must be ISO 3744 qualified using the ISO 3744 Annex A, A.3 Absolute Comparison Test. The sound power must be K_2 corrected for the 250 Hz to 10 kHz ⅓ octave range using the microphone sound power array. The overall A-weighted component target sound power, minus background A-weighted overall sound power, must be > 10 dB. (This is an allowed and GM approved deviation to avoid the use of ISO 3744 K_1 corrections, which are not allowed).

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

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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.

3.2.1 Microphone Array. Microphone and array requirements are defined in ISO 3744 and ISO 3745 sound power standards. The preferred hemispherical array contains 19 microphones at a 1 m radius over a reflecting plane as defined in Figure 1.

Figure 1: Preferred Microphone Array

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

3.2.3 Data Acquisition System (Acoustic). Data acquisition hardware capable of calculating frequency domain results between 22 Hz and 11 400 Hz, with a minimum of 80 dB dynamic range. This hardware shall meet Class 1 accuracy corresponding to IEC 651 or the equivalent for the application (precision ± 0.7 dB or ± 8%).

3.2.4 Data Acquisition System (Vibration and Other). Data acquisition hardware capable of calculating frequency domain results between 0 Hz and 11 400 Hz, with a minimum 80 dB dynamic range. This hardware shall meet Class 1 accuracy corresponding to IEC 651 or the equivalent for the application (precision ± 0.7 dB or ± 8%).

3.2.5 Accelerometer. High-sensitivity accelerometers with a flat frequency response from 5 Hz to 6.4 Hz and a temperature range appropriate for the application. The mass of the effect of the accelerometer shall be < 3% of the overall measurement.

3.2.6 Fifty (50) cm Microphone (Optional). The microphone specifications are the same as the 19 array microphones. A 50 cm microphone is placed directly above the blower unless otherwise specified. (It is available for positioning anywhere desired). This microphone is not used in the calculation of sound power.

3.2.7 Thermocouple. A thermocouple is used to measure the ambient temperature. Equipment tolerance is ± 1 °C.

3.2.8 One Current Measurement Devices. Use a Direct Current (DC) and Alternating Current (AC) 0 Hz to 6400 Hz-capable inductive current clamp to measure current. Use a current clamp with at least a 50 mA to 10 A range and a tolerance of 3% or reading ± 50 mA.

3.2.9 One Voltage Divider Box. The blower voltage must be within the measurement system's input voltage range. The use of a voltage divider may be required.

3.2.10 Air Flow Meter. The air flow meter must be capable of the following:

- Flow range: 3.5 L/s to 45 L/s, with accuracy of < ± 0.2 L/s (5%) at 3.5 L/s and < ± 0.5 L/s (1%) at 20 L/s.

3.2.11 Air Control System. The air control system includes ducts, pipes, a flow meter and simulated system loads (or filters), it does not include the blower. The defined air flow system shall be tested with a minimum of

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three fixed loads to simulate the typical system loads for the vehicle systems using the blower, see Figure 2. These coefficients of resistance simulate the pressure drop of the thermal management system (series of ducts, device to be thermally managed).

Figure 2: Filters for Simulating System Loads

The test system ducting shall not contribute to the sound power of the test compartment. There shall be a minimum of 10 dB separation of blower overall sound power to duct noise (remote blower). This is achieved using short test ducts.

To measure the inlet sound power, the load and flow meter shall be connected to the blower outlet. For this measurement, the blower shall be tested with the blower shaft axis in the vertical orientation. This may require that the inlet sound power be tested with a duct having a 90 degree bend, see Figure 3.

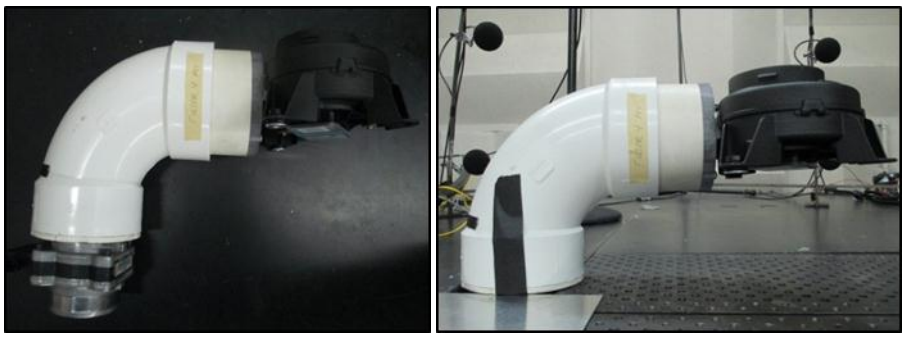

Figure 3: Setup for Measurement of Inlet Sound Power

To measure the outlet sound power, the load and flow meter shall be connected to the blower inlet, see Figure 4. For this measurement, the blower shall be tested with the blower shaft vertical and the blower inlet down.

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