Electric Air Conditioning Compressor Component Level N & V 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 method of quantifying electric air conditioning (AC) compressor operating noise and vibration related emission at a component level. This includes, radiated sound power, discharge line pressure pulsation, suction line pressure pulsation and compressor attachment boss vibration levels.

1.2 Foreword. These factors correlate to vehicle level compressor noise in the passenger compartment.

1.3 Applicability. This test procedure is appropriate for all electric AC compressor components used in hybrid vehicles to condition and cool air in the passenger compartment.

2 References

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

2.1 External Standards/Specifications.

ANSI S1.11	IEC 61260
ANSI S12.34	ISO 3744
ANSI S12.35	ISO 3745
DIN 45652	JIS Z8732
IEC 651	JIS Z8733

2.2 GM Standards/Specifications.

GMW14172	GMW14181

2.3 Additional References.

Roush GM Accessory Drive Test Procedure Number 96225: This operating procedure defines test details specific to ISO 3745 sound power testing at Roush Industries. This procedure is available through the N & V Resource Center.

Isolators: R1/RD1 series neoprene mountings produced by VMC-Korfund are typically used to isolate the compressor. Information for these isolators is available online.

3 Resources

3.1 Facilities. Semi-anechoic test cell meeting requirements defined in ISO 3745 or ISO 3744 standards.

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.

3.2.1 Compressor Control System. A Controller Area Network (CAN) bus (GM Local Area Network (GMLAN) single wire CAN bus) and CAN software (such as CANalyzer, Vehicle Spy, or CAT Tool) are required to communicate with the electric compressors, control the compressor operating speed, and capture the speed feedback from the compressor.

3.2.2 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 and Figure 2.

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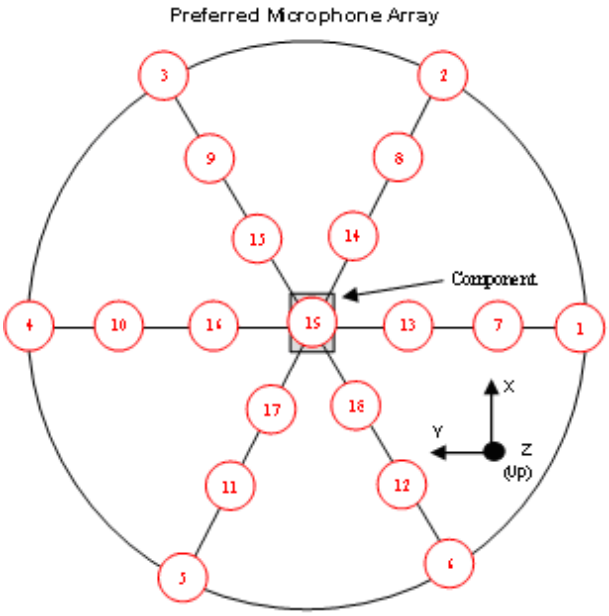

Figure 1: Preferred Test Stand Microphone Array

Microphone Position	X/r	Y/r	Z/r
1	0.00	-0.99	0.15
2	0.86	-0.50	0.15
3	0.86	0.50	0.15
4	0.00	0.99	0.15
5	-0.86	0.50	0.15
6	-0.86	-0.50	0.15
7	0.00	-0.89	0.45
8	0.77	-0.45	0.45
9	0.77	0.45	0.45
10	0.00	0.89	0.45
11	-0.77	0.45	0.45
12	-0.77	-0.45	0.45
13	0.00	-0.66	0.75
14	0.57	-0.33	0.75
15	0.57	0.33	0.75
16	0.00	0.66	0.75
17	-0.57	0.33	0.75
18	-0.57	-0.33	0.75
19	0.00	0.00	1.00

Figure 2: Preferred Microphone Array Coordinates

3.2.3 Accelerometers. Tri-axial accelerometers with low sensitivity (10 mv/g typical), a flat frequency response between 2 Hz and 2000 Hz, and a temperature range between 10 °C and 120 °C shall be used.

3.2.4 Pressure Transducers. Pressure transducers with a flat frequency response between 5 Hz and 1200 Hz, a measurement range exceeding 1500 kPa, and a temperature range between 0 °C to 135 °C shall be used.

3.2.5 Power Supply. A variable DC power supply with sufficient power to provide 400 V of power to the compressor motor and 13 V for compressor control is required. The suggested minimum output requirements are 400 V and 37 A.

3.2.6 Data Acquisition Equipment. Multichannel data acquisition hardware capable of calculating frequency domain results between 0 Hz and 11.25 kHz, with a frequency resolution between 2 Hz and 4 Hz, and a minimum dynamic range of 80 dB is required.

This hardware shall meet class 1 accuracy corresponding to IEC 651 or be equivalent for the application (precision ± 0.7 dB or ± 8%).

3.2.7 AC Load Cart. A device capable of controlling the AC system load applied to the compressor.

3.3 Test Vehicle/Test Piece. One compressor representing the design under test is required.

3.4 Test Time.

Calendar time:	2 days
Test hours:	8 hours
Processing time:	6 hours
Coordination hours:	2 hours

3.5 Test Required Information. The compressor nominal operating voltage and instructions for the electric compressor control system must be provided for testing.

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

In addition, knowledge of Heating Ventilation and Air Conditioning (HVAC) charging systems and operation of the motor/controller used to drive the compressor is required.

4 Procedure

4.1 Preparation.

4.1.1 Compressor Mounting. Proper orientation of the AC compressor is critical to its performance. Check with the customer, or manufacturer, prior to the installation of a new compressor.

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