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Hydraulic Pump Airborne Noise Bench Test

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FOREWORD

This document was created to set a standard test method for measurement of airborne noise from hydraulic pumps commonly used in motor vehicle power steering systems.

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1. SCOPE

Communicate the process of accurately measuring sound power levels of positive displacement hydraulic pumps commonly used in ground vehicle steering systems. This recommended practice defines the pump mounting (pulley, belt tension, isolation), operating conditions (fluid, speed, temperature, pressure), room acoustics, instrumentation, noise measurement technique and data acquisition setup to be used. Included are recommendations for test sample size, and format for data presentation/reporting.

1.1 Purpose

Record a common method to perform testing among vehicle manufacturer and pump suppliers.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 ISO Publication

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3745:2003 Acoustics—Determination of sound power levels of noise sources using sound pressure—Precision methods for anechoic and hemi-anechoic rooms

2.1.2 IEC Publication

Available from International Electrotechnical Commission, 3, rue de Verambe, P.O. Box 131, 1211 Geneva 20, Switzerland, Tel: +41-22-919-02-11, www.iec.ch.

IEC 61672-1 Electroacoustics—Sound Level Meters—Part 1: Specifications

IEC 61672-2 Electroacoustics—Sound Level Meters—Part 2: Pattern Evaluation Tests

2.1.3 ANSI Publication

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI S1.11 Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters

3. DEFINITIONS

4. PROCEDURE

4.1 Introduction

This procedure is based on ISO Specification 3745 with sound power testing and a 19-microphone array. Details on further test parameters to standardize the measurement of hydraulic pump component airborne noise are provided.

4.2 Instrumentation

Multi-channel data acquisition hardware capable of a sampling rate of 48 kHz. This hardware shall meet class 1 accuracy corresponding to IEC 61672 or be equivalent for the application (precision ± 0.7 dB or $\pm 8\%$).

A tachometer is used to monitor the speed of the component under test and provides a control signal as well as a trigger for data acquisition in sweep modes. Two thermocouples are utilized to monitor the temperature of the component and fluid. Two static pressure transducers to measure pump outlet and inlet pressure. Two dynamic pressure transducers used in the pump outlet circuit are optional.

Microphone Array: Microphone and array requirements are defined in ISO 3745 sound power standard. The preferred hemispherical array contains 19 microphones at a 1 meter radius over a reflecting plane as defined in Figure 1 and Table 1. A 0.5 meter array is acceptable if the lowest frequency of interest is met according to ISO 3745.

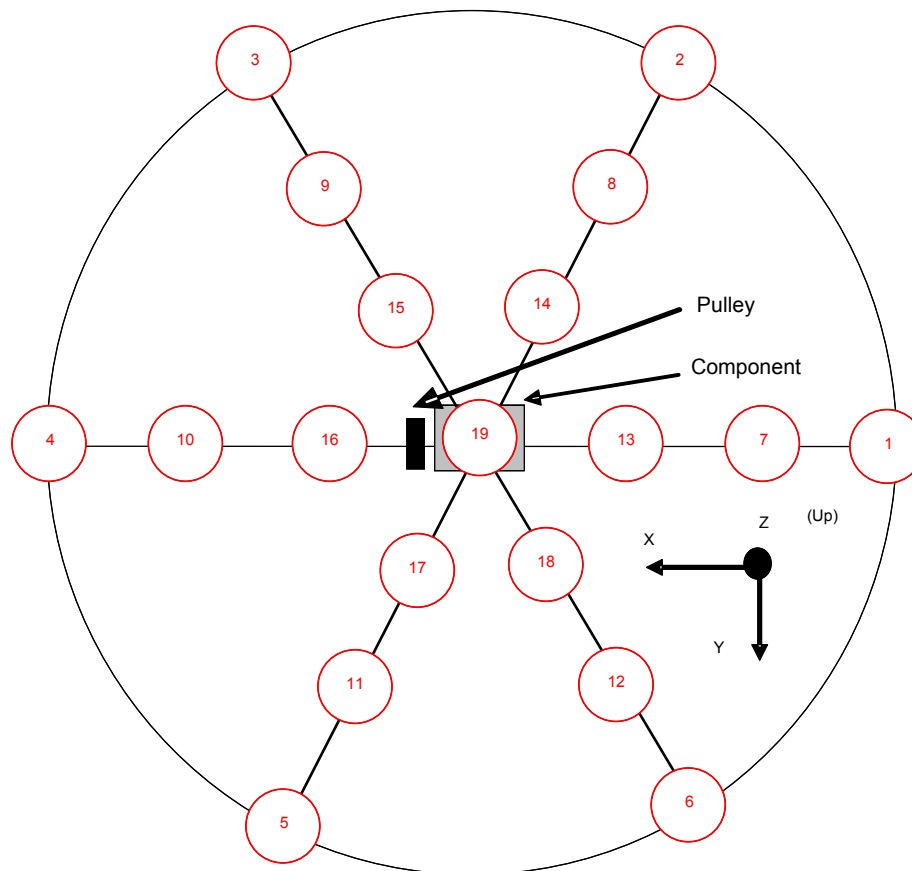


FIGURE 1 - PREFERRED TEST STAND MICROPHONE ARRAY

TABLE 1 - PREFERRED MICROPHONE ARRAY COORDINATES

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

4.3 Equipment and Facilities

4.3.1 Test Facility

The test stand is to be installed in a standard, flat-panel, semi-anechoic quiet room. The room shall have a low-frequency cut-off of 250 Hz, but due to the small size of the test components, measurements may be performed down to 200 Hz. The nominal background level of the room is 25 dB(A) with airborne and seismic noise isolation of 20 dB down from outside noise influences. The ambient temperature should not fluctuate from 21 °C more than ± 3 °C. The airborne noise performance of the test room should be hemi-anechoic with minimum noise “reflections” per standard ISO 3745. Reflective items or anything similar should be removed from the test cell prior to any noise testing.

The back ground level of motor noise without belt must be at least 12 dB below the pump overall noise level for the whole speed range.

If a test facility has a higher cut-off frequency, no data should be reported for the 1/3 octave bands whose center frequencies fall below the cut-off frequency, unless it requested and clearly identified in the test results.

4.3.2 Test Stand

The test stand (Figure 5) is comprised of a fully enclosed electric motor (40 HP typically sufficient for most applications), a silent driveline with journal bearings, and high precision idler pulleys. The motor controller powers the electric motor, and is connected to a control to run sweeps manually or as programmed by the user. A structurally isolated block (1.2 cm (1/2 in) minimum steel or aluminum) serves as a base for the mounting the test component. The base and drive system are mounted on a concrete base with an isolated reflecting plane covering the test stand. A 19-microphone hemispherical array, built according to ISO 3745 specifications, is used for sound power measurements. The microphone array has a 0.5 m or 1 m radius centered on the accessory component and is positioned on a reflecting plane which may be removeable. The microphone array is to be oriented with the rear microphone behind the pump back cover as shown in Figure 1.