SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

SAE J1400 | REV. MAY90

Issued 1982-05
Revised 1990-05

Superseding J1400 MAY89

(R) LABORATORY MEASUREMENT OF THE AIRBORNE SOUND BARRIER PERFORMANCE OF AUTOMOTIVE MATERIALS AND ASSEMBLIES

***Foreword*—**This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

***1. Scope*—**This SAE Recommended Practice presents a test procedure for determining the airborne sound barrier performance of materials and composite assemblies commonly installed in surface vehicles and marine products.

This document is intended to provide a means of rank ordering barrier materials according to their sound transmission loss. At each test frequency the transmission loss (TL) is projected from the measured noise reduction of the test specimen using a correlation factor (CF). The respective CF for the test condition is determined as the differences between the measured noise reduction (MNR) of a homogeneous limp panel, such as lead, and its calculated field-incidence transmission loss.

Latitude is permitted in certain test conditions that do not necessarily conform to all of the acoustical requirements of ASTM E 90. This method facilitates the evaluation of automotive materials and assemblies under conditions of representative size, edge constraint, and sound incidence so as to allow better correlation with in-use barrier performance.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J184—Qualifying a Sound Data Acquisition System

2.1.2 ANSI PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI S 1.1—Acoustical Terminology
ANSI S 1.4—Specification for Sound Level Meters
ANSI S 1.11—Specification for Octave Band and Fractional Octave Band Filter Sets

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-8512 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER; (412) 776-4970 FAX: (412) 776-0790
SAE WEB ADDRESS http://www.sae.org

2.1.3 INCE PUBLICATIONS—Available from INCE, P.O. Box 3206--Arlington Branch, Poughkeepsie, NY 12603.

Beranek, Leo L., Noise and Vibration Control, Revised Edition, Institute of Noise Control Engineering, New York, 1989.

2.1.4 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 90, Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

3. Instrumentation—The instrumentation to be used is as follows:

3.1 A sound level meter that meets the Type I requirements of ANSI S 1.4.

3.1.1 As an alternative to making direct measurements using a sound level meter, a microphone and measuring amplifier and/or sound level meter may be used with a graphic level recorder or other indicating instrument providing the system meets the requirements of SAE J184.

3.2 A third-octave filter set covering the range of center frequencies from 100 to 10 000 Hz; the filters shall meet the Class III requirements of ANSI S 1.11.

3.3 A sound level calibrator accurate to ±0.5 dB. (See 6.2)

3.4 An acoustical sound generating system shall be selected to generate a series of bands of random noise containing a continuous distribution of frequencies over each test band.

3.5 A schematic diagram of the instrumentation is shown in Figure 1.

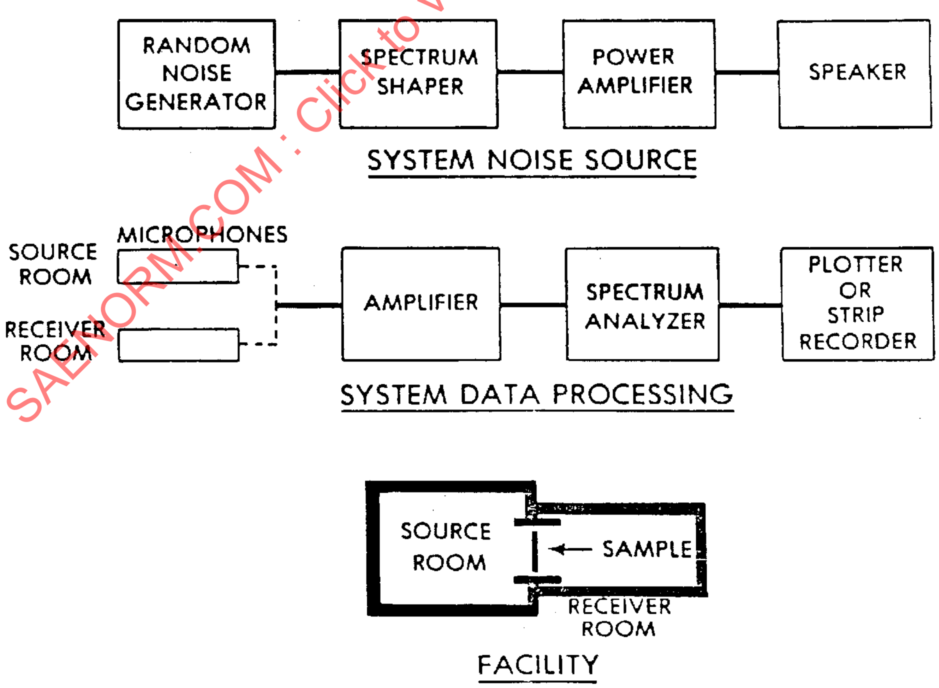

FIGURE 1—TYPICAL MEASUREMENT SYSTEM

3.6 Temperature and humidity indicators should be used to monitor dry and wet bulb temperatures and humidity.

4. ***Facilities*—**The following facilities are recommended for the measurement of noise reduction:

4.1 The source room should have an exterior wall construction of a sufficient sound transmission loss to eliminate flanking paths into the receiving room.

4.2 When the area of the wall separating the receiving room from the source room is large relative to the area of the sample under test, the measurements may be compromised by sound transmitted from source to receiving room via paths other than through the specimen under test. Refer to ASTM E 90 for the procedures to correct filler wall transmission.

4.3 The receiver room should be constructed to achieve a minimum difference of 10 dB between the test signal band level and the band level of the background noise in all frequency bands of interest.

4.4 A test sample fixture should hold the test sample securely between the source and receiver rooms. The fixture should be well sealed to prevent leakage between the source and receiver rooms through the fixture. The fixture should provide means to maintain typical in-use contact between applied barrier treatments and the base panel assembly.

4.5 One or more microphones shall be positioned within the source and receiver rooms. The number and spacing of microphone positions required in each room depends on the statistical precision desired in the time and space average band pressure levels.

4.6 When using a reverberant room, the diffusion in the reverberation room can be enhanced by the use of rotating or stationary diffusers.

4.7 The size of the opening between the source room and the receiver room limits the lowest frequency at which measurements can be reliably made.

NOTE—This lowest frequency is roughly determined by the length of the diagonal of the test specimen panel (see Table 1).

TABLE 1—TABLE FOR DETERMINING LOWEST FREQUENCY[(1)] OF MEASUREMENT FOR A GIVEN SAMPLE DIAGONAL (DIAMETER)

Diagonal of Opening, m (ft)	Lowest Measurement Frequency, Hz
0.5 (1.64)	172
0.75 (2.46)	114
1.00 (3.28)	86
1.25 (4.10)	69
1.50 (4.92)	57
1.75 (5.74)	49
2.00 (6.56)	43

1. Calculations use second speed of 343 m/s. This sound speed corresponds to an air temperature of 20 °C.

5. ***Procedure***

5.1 **Sample Mounting—**The test sample should be mounted in the test fixture simulating the edge constraint conditions of the in-use condition. Ancillary shielding or seals may be used to help ensure a minimum of sound transmission flanking the test sample.

5.2 Measurements—The background noise levels within both the source and receiver rooms shall be measured and noted in all measurement bands.

5.2.1 Install the reference sample, a homogeneous limp material such as lead, sealed into the test opening so that its field-incidence sound TL can be calculated from the relation:

$$TL(reference) = 20 \log_{10} W + 20 \log_{10} f - 47.2 \quad \text{(Eq. 1)}$$

where:

W = the surface density in kg/m^2
f = the center frequency of the one-third octave measurement band

Round off the calculated TL of the reference sample to the nearest 0.1 dB.

5.2.2 The source signal shall be filtered or shaped so that with the test sample sealed in place, the source room and receiver room signal levels are each 10 dB higher than the background noise levels in the respective facilities.

5.2.3 The time and space averaged third-octave band levels in both the source and receiver rooms shall be measured and recorded over the desired measurement bands with the reference sample sealed into the fixture in the test opening.

5.2.4 After removing the reference sample, the unknown test sample is installed and sealed into the same opening and the measurements of 5.2.3 are repeated.

5.3 Data Analysis—The following procedures are used to project the field incidence TL of the test sample:

5.3.1 Background Noise Correction—If necessary, correct for background noise levels using the equation:

$$L_S = 10 \log_{10} (10^{L_C/10} - 10^{L_B/10}) \quad \text{(Eq. 2)}$$

where:

L_S = level of the signal, dB
L_C = level of the signal and background noise combined, dB
L_B = level of the background noise alone, dB

NOTE—This correction is not necessary if the recommendations of 4.3 and 5.2.2 are met.

5.3.2 Compute the measured noise reduction for both the reference sample and the unknown test sample. Using the corrected band pressure levels for each measurement band subtract the receiver room band pressure level from the source room band pressure level to obtain the MNR for both samples.

5.3.3 Determine the CF applicable to the test opening and source and receiver room pair at each test frequency as the difference between the measured noise reduction of the reference sample, MNR(reference) and its calculated TL and TL(reference).

$$CF = MNR(reference) - TL(reference) \quad \text{(Eq. 3)}$$

Round the correlation factor to the nearest 0.1 dB.