



Sound Transmission Loss (STL) Master Test Procedure

1 Introduction

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. To measure the sound transmission loss of a panel in a standardized fixture and installed in a window between a reverberation room and anechoic chamber.

1.2 Applicability. This test procedure is appropriate for the evaluation of the sound transmission loss of any test sample that can be incorporated into a fixture that will fit into an opening between a reverberation room and an anechoic chamber.

This is a generalized procedure for measuring the sound transmission. Information specific to a particular test specimen will be provided in separate validation test procedures.

1.3 Remarks. This test is to be used for the purpose of establishing new product goals through the benchmarking of competitive components and subsystems, the development of new product program designs to achieve the specified vehicle interior sound, and the validation of components and subsystems specified for new product programs. This test procedure shall be followed in its entirety.

2 References

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

2.1 External Standards/Specifications.

ANSI S1.11	ASTM E336	SAE J1400
ASTM E90	SAE J184	

2.2 GM Standards/Specifications.

GMW14172

2.3 Additional References.

- **Sound Intensity**, B&K Booklet, 1993.

3 Resources

3.1 Facilities. This test procedure shall be performed with a test sample installed in a standardized test panel installed in an opening between a reverberation room and an anechoic room.

- **Source Room:** The source room shall be a reverberation room. The room diffusivity shall meet ASTM E90 standards or at minimum shall meet ASTM E336 standards to be deemed acceptable.
- **Receiving Room:** The receiver room shall be an anechoic chamber.
- All flanking that could affect the measurement of intensity in the receiving room shall be minimized to ensure adequate quality of intensity measurement.

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.

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3.2.1 Test Equipment.

Note: Equipment with equivalent specifications is acceptable.

3.2.1.1 Multi-channel analyzer meeting SAE J184, with microphones and amplifiers meeting SAE J184.

3.2.1.2 Capability to reduce data meeting Class III one-third octave filters per ANSI S1.11 and cover the center frequencies from 200 Hz to 10 000 Hz.

3.2.1.3 Transducer(s) capable of measuring sound intensity in the frequency range of 200 Hz to 10 000 Hz one-third octave band center frequencies.

3.2.1.4 Sound intensity transducer calibrator.

3.2.1.5 Sound level calibrator accurate to ± 0.5 dB.

3.2.1.6 A random noise signal generator.

3.2.1.7 Graphic Equalizer with minimum 24 dB dynamic range.

3.2.1.8 Power amplifier with minimum 75 W/channel.

3.2.1.9 Miscellaneous equipment including but not limited to: appropriate cables, microphone stands, adhesive substances (duct tape, permagum, spray adhesive, etc.,) instrument to locate leaks in specimen fixture and transducer signal conditioning if needed.

3.3 Test Vehicle/Test Piece. The test specimen shall be qualified to ensure that it represents design intent. All boundaries and interfaces must be represented correctly. If the test specimen is not design intent, the deviations shall either be corrected or otherwise noted on the test description sheet.

3.4 Test Time. See validation test procedures for test times.

Calendar time: 2 d

Test hours: 4 h

Coordination hours: 1 h to 2 h (all)

3.5 Test Required Information. Not applicable.

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

4 Procedure

The Sound Transmission Loss (STL) of the test panel or buck will be computed by measuring the L_P in the source room and the transmitted intensity level in the receiving room. Calculations will be performed using this data to compute the STL and are described in the appendices.

4.1 Preparation.

4.1.1 Test Specimen Preparation. Reference Appendix A for the proper procedure used to prepare the test specimen panel in the test fixture.

Details specific to a test specimen will be addressed in separate validation test procedures.

4.1.1.1 Limp Material Reference Panel. The reference panel will be used to validate the accuracy of the facility in measuring STL and to develop correction factors to be applied, if necessary, to the data acquired on the test specimens.

A reference sample, a homogenous limp material such as lead, shall be prepared such that it fits into the same opening as the test specimen. The test specimen shall be made of a material with a known surface mass density such that its STL can be calculated:

$$STL = 20\log_{10}(W) + 20\log_{10}(f) - 47.2$$

Where:

W = Surface mass density of material in kg/m^2

f = Center frequency of the one-third octave measurement band

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Measure the surface area of the limp material that is being used for the test and weigh the sample to determine the surface mass density in kg/m^2 . Do not rely on nominal surface mass densities. When measuring STL according to this procedure, the deviation between the measured STL and the theoretical STL of the reference limp mass material shall be correctable to less than 1 dB deviation from mass law.

Ensure that the setup in the reverberation and anechoic chambers does not change between data collection for the reference panel and the test specimen.

4.1.1.2 Flanking Check Panel. This is a panel with a high level of acoustic treatment and shall be used for the purpose of determining whether there are noise flanking paths associated with the test fixture that will contaminate the data. It will be used to track changes in the facility due to wear of the acoustic seals.

The STL of the **flanking check** panel will also be used to define the upper limit of the STL measurement and shall be noted in the report. Therefore, the STL of the **flanking check** panel shall be at least as high as the highest level that is expected to be measured for the test specimen. It is recommended that the STL be a minimum of 90 dB at 10 kHz.

4.1.2 Test Preparation.

4.1.2.1 Overview. The measured sound pressure level at multiple locations in the source room and the measured transmitted intensity level in the receiving room will be used to compute the STL. Details of calculations are described in the appendices. It is recommended that the data for each measurement be checked before proceeding to the next measurement.

4.1.2.2 Source Room. The source room shall be a reverberation room.

Locate microphones per ASTM E90 standards to determine the space-averaged sound pressure level of the source room. If stationary microphones are used, the microphones shall remain in the same locations for all measurements.

4.1.2.3 Receiving Room. The receiving room shall be an anechoic chamber.

The preferred method is to locate an analyzer outside the anechoic room with an extension cable to position the intensity probe inside the anechoic room. If an analyzer is located in the receiving room, use a barrier to ensure that the analyzer fan noise does not affect measurements.

4.2 Conditions.

4.2.1 Environmental Conditions.

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.

4.3.1.1 Transducer System Calibration. See calibration master procedure GMW14172 for details.

4.3.1.2 Acquisition System Calibration. Periodic calibration of the data acquisition system shall be performed per manufacturer's specifications.

4.3.2 Data Acquisition Setup. Source room data and receiver room data shall be acquired with appropriate signal processing such that the end result is one-third octave band data for the frequency range of 200 Hz to 10 000 Hz. The source room and receiver room data shall have the same final weighting.

4.3.3 Install Limp Material Reference Panel (Lead Panel). The objective of measuring the homogenous limp panel is to ensure that the STL being measured is correct relative to a known value.

4.3.4 Adjust Source Noise Levels. Use graphic equalizer and amplifiers to create appropriate L_p source spectrum required such that levels in receiver room meet SAE J1400 background noise criteria.

4.3.5 Acquire Source Room L_p . With the noise source on acquire source room levels. Do not turn off the noise source and proceed to receiving room measurement.

4.3.6 Acquire Receiving Room L_i .

4.3.6.1 Measurement Surface. Define the scan plane to be a flat hypothetical surface, usually 0.1 m to 0.3 m from panel to center of measurement system. Shorter distances (less than 0.1 m) should be avoided because of near field effects. At longer distances (greater than 0.3 m) the reactivity of the sound field may increase. If construction is such that the panel is recessed by more than 0.1 m in the receiving room wall, measurements shall be made at the exit plane.

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