

RECOMMENDATIONS FOR INCORPORATING ACOUSTICAL TESTING INTO PROJECT SPECIFICATIONS

Spectra Tech Ltd is a consulting firm which provides specialized services in the field of acoustics, sound, and vibration control. In addition to providing design consultation to architects, engineers, and facility managers, we also provide onsite testing services to determine acoustical performance. The testing is useful in evaluating problems with existing construction, and is also used extensively to certify new construction. Most importantly, our staff can provide field assistance to installers during testing, to correct any performance deficiencies which we might discover.

Since 1989, Richard Lemker has conducted acoustical testing using proprietary computer hardware and software, and has conducted hundreds of field tests using our system. Virtually all of the hundreds of clients, manufacturers, architects, and engineers, contractors, and government agencies that we have served have told us that our services are in effect the most accurate, economical and efficient services available anywhere in the United States.

Field testing to certify the acoustical performance of various products and elements has proven that high performance values cannot be achieved without such field testing and adjustment. In addition, "lab" test ratings are rarely achieved "in the field". In order to assist you in incorporating acoustical testing into your project specifications, we offer the following information.

TYPES OF ACOUSTICAL TESTING AVAILABLE FROM SPECTRA TECH

SOUND TRANSMISSION RATINGS

This test is used to rate the sound attenuation performance of doors, windows, walls, and floor/ceiling assemblies. Most often, the ratings are expressed in terms of Field Sound Transmission Class (FSTC) values, which are field performance values obtained from materials which are lab-tested and specified in terms of Sound Transmission Class (STC) values. Other rating which may be determined include Noise Reduction (NR), Noise Isolation Class (NIC), Transmission Loss (TL), etc. All such testing is conducted in accordance with ASTM standard #E336, entitled "Standard Test Method for Measurement of Airborne Sound Insulation in Buildings".

In general, this testing should be specified to certify performance whenever values of FSTC \geq 40 or greater are intended. Situations include auditoriums, conference and meeting rooms, music rooms, military security installations, testing facilities, broadcast studios, condominiums, private executive offices, etc.

FLOOR IMPACT ISOLATION RATINGS

This test is used to rate the performance of floor/ceiling assemblies which separate rooms of interest from problem spaces above or below. Rating are expressed in terms of Impact Isolation Class (IIC) values. Testing is conducted in accordance with ASTM standard #E1007, entitled "Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies & Associated Structures".

This test should be specified whenever there is a need to protect a sensitive area from structurally transmitted noise caused by occupants and equipment located on the floor above or below. Common situations requiring floor/ceiling isolation include mechanical equipment rooms located over or under sensitive spaces, multistory condominiums, etc.

AMBIENT NOISE LEVEL RATINGS

These tests are used to rate the relative loudness of background noise levels in facilities. Background noise is normally considered to be the noise caused by operation of the building's HVAC system and other equipment, as measured when no occupants are present. There is an optimum value for ambient noise levels in every facility, based upon the facility's intended use. Facilities used for speech communication and audio program presentation require low ambient noise levels, while other facilities such as open plan office spaces and public areas actually desire higher ambient noise levels to protect privacy. Ratings for background noise levels are commonly expressed in terms of Noise Criteria (NC) or Room Criteria (RC) Curves, in accordance with ASHRAE standards.

ROOM REVERBERATION RATINGS

Reverberation testing is used to rate the amount of time required for a sound to diminish in intensity to the point of inaudibility, after it is originally introduced into a room. Performance is most often expressed in terms of the time required for the sound to decay 60 decibels (RT60), and is determined in one octave or one-third octave frequency bands in the audible frequency range of interest.

Reverberation testing should be conducted whenever the project has a particular reverberation time goal, such as in auditoriums, churches, and most other facilities which are used for speech communication or musical presentations.

SPEECH PRIVACY RATINGS

Speech privacy testing is used to rate the amount of privacy provided by the facility, based on given source sound levels, ambient noise levels, and sound transmission loss of elements of construction. Performance can be rated in a number of ways, and is most often expressed in terms of the Articulation Index (AI), Speech Intelligibility of Sentences Known to Listeners (SISK), Speech Intelligibility of Sentences First Heard by Listeners (SISF), or the Privacy Index (PI). Testing is conducted in accordance with the ANSI standard #S3.5

Speech privacy testing should be specified whenever there is a need to develop confidential

privacy, such as corporate board rooms, confidential offices, government and military security areas, condominiums, etc.

SOUND LEVEL RATING

Sound level tests are used to report the loudness of a particular sound source in terms of decibels (dB). Sound pressure level (SPL) can be reported as a single number, or reported in one octave or one-third octave frequency bands. The SPL can be "unweighted" (normal) or "weighted", such as "A-Weighted" to express the value in dBA. There is no particular standard which governs the measurement of sound levels. Performance standards for a particular project can specify maximum sound levels for a given sound source (e.g. equipment), or specify minimum sound level output for amplification systems.

RECOMMENDED WORDING FOR TEST SPECIFICATIONS

Step 1:

- a. Identify within specifications the products or elements of construction that are to be tested. If a product or element of construction is used in multiple locations, each location should be tested, as field performance can vary from location to location.
- b. Specify the performance value which must be achieved for the installed product or element of construction.
- c. Identify the testing standard (if applicable) by which testing should be conducted.
- d. Certification of the specified performance "in the field" should be listed as a condition of final acceptance in the Contract. Submittal of lab test data should not be accepted.

Step 2:

- a. Specify the testing and adjustment procedure which must be used.
We recommend that the following wording be inserted into the description of the test procedure:

"Contractor shall retain the services of an independent acoustical consultant to perform all tests. Acoustical consultant shall utilize a computer-based testing system to perform tests and rate performance. Sound level samples shall be taken at a minimum of 10 microphone positions at each test location. Sound level data shall be transmitted directly from the data output buss of the real time audio test analyzer to the D/A input card of the computer system. The computer system shall log and record at least 24 "real time" 1/3 octave sound level samples from each microphone test position, yielding a minimum total of 240 sound level samples at each test location. Data recorded at each microphone position shall be reviewed by acoustical consultant, who may, at their option, delete individual sound level samples believed to be inconsistent with the majority of other data samples, due to factors such as intrusion of extraneous noise, unusual surface reflections, room modes, etc.

Final determination of the average sound level at each test location shall be calculated by the computer system, using a minimum of 144 acceptable 1/3 octave samples. Accuracy and 95% confidence limits for average sound level values shall be plus or minus 2 dB. for the 1/3 octave bands centered on 125 and 160 Hz., plus or minus 1.5 dB. for bands centered on 200 and 250 Hz., and plus or minus 1 dB. for the bands centered in the range from 315 to 8000 Hz. Data shall be stored on hard disk media for use in subsequent calculations and printout.

Following completion of sound level data acquisition, the test system operator shall run computer program routines at the test site to calculate the performance values for the product or element of construction, and display the results on the computer CRT in graph or list format. Performance values for each test shall be stored on hard disk media for use in subsequent calculations and report printouts.

If the performance of the product or element of construction is found to be deficient, acoustical consultant shall assist Contractor in identifying the cause of such deficiencies. Contractor shall immediately adjust, repair, or replace the product or element of construction in accordance with acoustical consultant's recommendations, and retest, until satisfactory performance is achieved.

Following the conclusion of field testing and achievement of specified performance values, acoustical consultant shall provide a printed field test report, certifying performance. Contractor shall submit test reports with as-built documentation.

Approved source for acoustical testing and consultation:

Spectra Tech Ltd
Cincinnati, Ohio
Phone: (513) 419-9169

Step 3:

- a. Monitor Contractor's work, and require compliance with specifications.

OTHER RECOMMENDATIONS

The information and recommended specification methods described above are provided as a courtesy, without charge. However, we must caution you in their use, as there are possibilities for specifying incorrect products or selecting the wrong test procedure for your application, ultimately resulting in an inability to achieve the performance you might specify. We cannot be responsible for misapplication of this information.

We strongly recommend that you contact Spectra Tech during design and preparation of specifications, in order to assure that the desired performance results will ultimately be achieved.

Our firm can recommend optimum performance specifications and provide assistance in specification of products and construction methods which will provide the desired performance, if you wish. Such consultation is provided on an hourly fee basis.