

BUILDING ACOUSTICS

SOUND INSULATION – A UNIVERSAL PROBLEM

Sound energy does not remain in the room where it is produced, but propagates throughout the building by any available path, intruding into other rooms as noise. Each country has its own standards of sound insulation in buildings, but it is measured in the same way all over the world.

Airborne Sound Insulation

Airborne sound insulation is a measure of how well sound from acoustical sources (for example, voices) is reduced from one room to another room. To measure sound insulation, a loudspeaker producing pink noise is located in one room (the source room). The noise levels in the two rooms under investigation are measured and subtracted, and the level difference is corrected for the influence of the absorption (measured by reverberation time) and background noise level in the receiving room. The measurements and calculations are made in $1/1$ - or $1/3$ -octave bands and averaged over a number of positions in the rooms. Finally a single-number index is calculated over all the frequency bands.

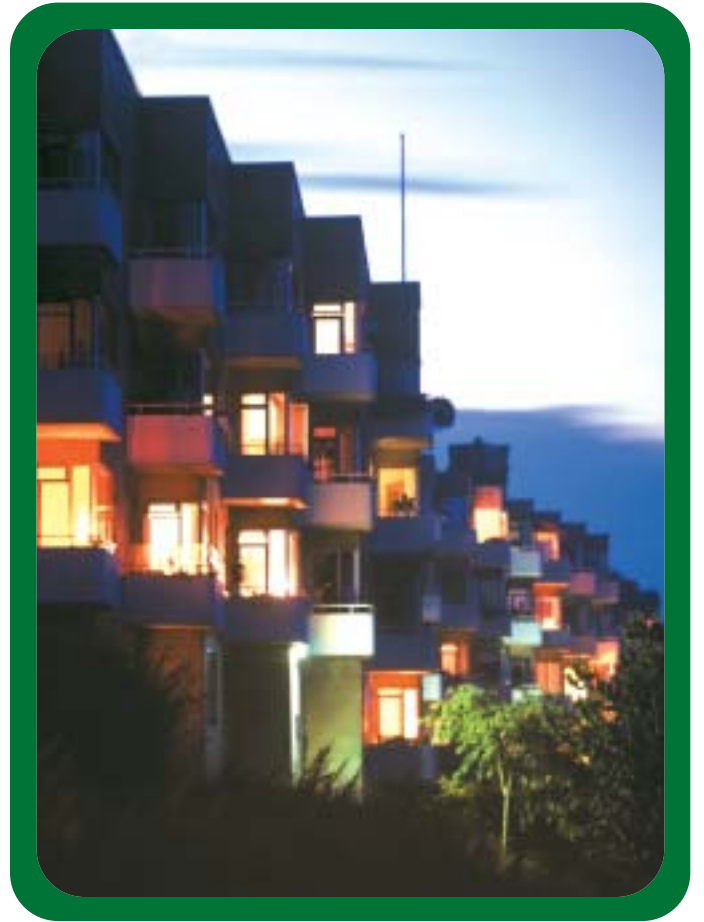
Façade Sound Insulation

Façade sound insulation is measured like sound insulation

between rooms, except that one "room" is open space. The sound level is measured inside the receiving room and outside the façade of the building. The level difference is then corrected for the influence of the reverberation time and background noise level in the receiving room. Finally a single number index is calculated by averaging over all the frequency bands. A loudspeaker source can be used for the measurement, giving a choice of sound incidence angle.

Two Channels for Façade Sound Insulation

Instead of using a loudspeaker source, it is sometimes better to use existing traffic noise. The measurement then relates to actual conditions for source type and sound incidence. But since the sound level varies over time, the levels outside and inside the room must be measured at the same time. Two-channel measurement is essen-



tial to achieve this. For several measurement positions, the average of the outdoor-indoor level differences is taken rather than the difference of the average levels in each room.

Impact Sound Level

Impact sound, such as the noise made by footsteps, is simulated using a standardised tapping machine. When measuring, the tapping machine is placed in the source room and the level is measured in the receiving room and corrected for influence of reverberation time and background noise. A single-number index is calculated as above. Sometimes it is also necessary to correct for the produced airborne sound from the tapping machine. In this case the source room level also has to be measured.

Reverberation Time in Practice

Reverberation time is measured using either interrupted noise (pink or white) from a loudspeaker source, or impulsive noise from a starting pistol. It is measured in $1/1$ - or $1/3$ -octaves, serially or simultaneous-

ly in all bands. It is usually averaged over several positions in the room and over several decays in each position. Quite often a wide-band average is calculated by mathematically averaging the reverberation time for a range of frequency bands. For critical applications, the shape of the decay curve is also important. Deviations from the straight line can reveal acoustical defects.

Laboratory Versus Field Measurements

For checking constructions such as windows, floors and walls, laboratories use test suites consisting of two adjoining rooms. The test sample is mounted in a test opening between the two rooms. The two rooms are designed to eliminate the influence of flanking transmission and background noise. This ensures that results truly reflect

the sound reduction of the sample. When checking sound insulation in actual buildings (field or in situ situations), the results are often influenced by flanking transmission. To indicate this, results are often identified by adding a prime (like in R').

Troubleshooting Sound Insulation using Sound Intensity

Quite often, traditional measurement will show that the sound insulation is not as good as expected or required by law. If this is the case, a measurement using sound intensity can diagnose the fault by showing the contribution of each surface element to the sound reduction index. If you suspect a certain weak area, the contribution for that area can be measured and checked separately.

Or you can divide the partition into smaller sections and check each section until you find the fault. This measurement method also eliminates flanking transmission (or, by subtraction, lets you estimate its influence), and is ideal for detecting and measuring the influence of leaks. To measure the sound reduction index for a surface element you have to measure the level in the source room and scan the probe over the measurement surface in the receiving room.



Product Guide

Brüel & Kjær offers solutions to all the above-mentioned applications. Please use this table as a guide to relevant products.

Application	Key Features	Products and their Key Features
Airborne Sound Insulation Façade Sound Insulation Impact Sound Level Reverberation Time	1) $1/1$ - and $1/3$ -octave Spectra 2) T_{20} , T_{30} 3) Two-channel Measurement 4) Calculate Sound Insulation 5) Documentation	2260 Observer 1) 2) 2260 Investigator 1) 2) 3) 4) 7830 Qualifier 4) 5) 7842 Classifier 1) 2) 3) 4) 5)
Troubleshooting Sound Insulation using Sound Intensity	Intensity Spectra L_W and L_W Mapping	2260 Investigator 3560 PULSE

030241