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Acoustics — Field measurements of airborne and impact sound insulation and of service equipment sound — Survey method

Acoustique — Mesurages in situ de l'isolement aux bruits aériens et de la transmission des bruits de choc ainsi que du bruit des équipements — Méthode de contrôle

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Foreword

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ISO 10052 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

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Foreword

This document (EN ISO 10052:2004) has been prepared by Technical Committee CEN/TC 126 “Acoustic properties of building products and of buildings”, the secretariat of which is held by AFNOR, in collaboration with Technical Committee ISO/TC 43 “Acoustics”.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This document describes survey test methods which can be used for surveying the acoustic characteristics of the airborne sound insulation, impact sound insulation and of the sound pressure levels from service equipment. The methods may be used for screening tests of the acoustical properties of buildings. The methods are not intended to be applied for measuring acoustical properties of building elements.

The approach of the survey methods is to simplify the measurement of sound pressure levels in rooms by using a hand-held sound level instrument and by manually sweeping the microphone in the room space. The correction for reverberation time can be either estimated by usage of tabular values or be based on measurements. The measurement of airborne and impact sound insulation is carried out in octave bands. For measuring sound from domestic service equipment, A - or C -weighted sound pressure levels are recorded.

Measurements are performed with specified operation conditions and operation cycles. The operating conditions and operating cycles given in Annex B are only used if they are not opposed to national requirements and regulations.

The measurement uncertainty of the results obtained using the survey method is a priori larger than the uncertainty inherent in the corresponding test methods on engineering level.

NOTE Engineering methods for field measurements of airborne and impact sound insulation are dealt with in EN ISO 140-4 and EN ISO 140-7. Engineering methods for field measurements of airborne sound insulation of façade elements and façades are dealt with in EN ISO 140-5. An engineering method for measurement of service equipment sound is dealt with in EN ISO 16032.

1 Scope

This document specifies field survey methods for measuring:

a) airborne sound insulation between rooms;

b) impact sound insulation of floors;

c) airborne sound insulation of façades; and

d) sound pressure levels in rooms caused by service equipment.

The methods described in this document are applicable for measurements in rooms of dwellings or in rooms of comparable size with a maximum of 150 m^3.

For airborne sound insulation, impact sound insulation and façade sound insulation the method gives values which are (octave band) frequency dependent. They can be converted into a single number characterising the acoustical performances by application of EN ISO 717-1 and EN ISO 717-2. For service equipment sound the results are given directly in A - or C -weighted sound pressure levels.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 20140-2, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 2: Determination, verification and application of precision data (ISO 140-2:1991).*

EN 61260, *Electroacoustics - Octave-band and fractional-octave-band filters (IEC 61260:1995).*

EN 60651, *Sound level meters (IEC 60651:1993).*

EN 60804, *Integrating-averaging sound level meters (IEC 60804:2000).*

EN ISO 140-7:1998, *Measurements of sound insulation in buildings and of building elements — Part 7: Field measurements of impact sound insulation of floors (ISO 140-7:1998).*

EN ISO 717-1, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation (ISO 717-1:1996).*

EN ISO 717-2, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 2: Impact sound insulation (ISO 717-2:1996).*

EN ISO 3822-1, *Acoustics - Laboratory tests on noise emission from appliances and equipment used in water supply installations - Part 1: Method of measurement (ISO 3822-1:1999)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
average sound pressure level in a room $\overline{L}$
ten times the logarithm to the base 10 of the ratio of the space and time average of the sound pressure squared to the square of the reference sound pressure, the space average being taken over the entire room with the exception of those parts where the direct radiation of a sound source or the near field of the boundaries (wall, etc.) is of significant influence. It is expressed in decibels as:

$$\overline{L} = 10 \lg \frac{\frac{1}{T_m} \int_0^{T_m} p^2 \left(t \right) \mathrm{d}t}{p_0^2} \text{ dB} \qquad (1)$$

where

p is the sound pressure level, in Pascal, p_0 = 20 µPa is the reference sound pressure;

T_m is the integration time in seconds

3.2
level difference *D*
difference in the space and time average sound pressure levels produced in two rooms by one sound source in one of them. It is expressed in decibels as:

$$D = \overline{L}_1 - \overline{L}_2 \quad \text{dB} \qquad (2)$$

where

$\overline{L}_1$ is the average sound pressure level in the source room, in decibels;

$\overline{L}_2$ is the average sound pressure level in the receiving room, in decibels

3.3
reverberation index *k*
ten times the logarithm to the base 10 of the ratio of the actual reverberation time T of the receiving room to the reference reverberation time T_0. It is expressed in decibels. This quantity is denoted by:

$$k = 10 \lg \frac{T}{T_0} \text{ dB} \qquad (3)$$

where

T_0 = 0,5 s

3.4
standardized level difference D_{nT}
level difference corresponding to a reference value of the reverberation time in the receiving room. It is expressed in decibels as:

$$D_{nT} = D + k \quad \text{dB} \qquad (4)$$

where

D is the level difference (see equation (2)), in decibels;

k is the reverberation index (see equation (3)), in decibels

3.5
normalized level difference D_n
level difference D corresponding to the reference absorption area in the receiving room. It is expressed in decibels as:

$$D_n = D + k + 10 \lg \frac{A_0 T_0}{0{,}16 \ V} \text{ dB} \quad (5)$$

where

k is the reverberation index;

T_0 is the reference reverberation time ($T_0 = 0{,}5$ s);

V is the volume of the receiving room, in cubic metres;

A_0 is the reference equivalent absorption area, in square metres, ($A_0 = 10$ m^2);

0,16 has the unit s/m

3.6
apparent sound reduction index R'
ten times the logarithm to the base 10 of the ratio of the sound power W_1 which is incident on a partition under test to the total sound power transmitted into the receiving room, if, in addition to the sound power W_2 transmitted through the separating element, the sound power W_3, transmitted through flanking elements or by other components, is significant.

It is expressed in decibels as:

$$R' = 10 \lg \frac{W_1}{W_2 + W_3} \text{ dB} \quad (6)$$

NOTE 1 The expression "apparent sound transmission loss" is also in use in English-speaking countries. It is equivalent to "apparent sound reduction index".

Under the assumption of diffuse sound fields in the two rooms, the apparent sound reduction index in this document is calculated from:

$$R' = D + k + 10 \lg \frac{S \ T_0}{0{,}16 \ V} \text{ dB} \quad (7)$$

where

D is the sound pressure level difference, in decibels;

k is the reverberation index;

S is the area of the partition, in square metres;

V is the volume of the receiving room, in cubic metres;

T_0 is the reference reverberation time (T_0 = 0,5 s);

0,16 has the unit s/m.

In the case of staggered or stepped rooms, S is that part of the area of the partition common to both rooms. If the common area between the stepped or staggered rooms is less than 10 m^2, this shall be indicated in the test report. If $V/7{,}5$ is larger than S, insert this value for S where V is the volume in m^3 of the receiving room which should be the smaller room.

In the case that no common area exists the normalized level difference D_n shall be determined.

NOTE 2 In the apparent sound reduction index, the sound power transmitted into the receiving room is related to the sound power incident on the common partition irrespective of actual conditions of transmission.

The apparent sound reduction index is independent of the measuring direction between the rooms if the sound fields are diffused in both rooms

3.7
impact sound pressure level L_i

average sound pressure level in the receiving room when the floor under test is excited by the standardized tapping machine. It is expressed in decibels. If more than one position of the tapping machine is used, the impact sound pressure level is calculated by averaging the sound pressure levels $L_{i,n}$ at N positions according to:

$$L_i = 10 \lg \left(\frac{1}{N} \sum_{n=1}^{N} 10^{L_{i,n}/10} \right) \text{ dB} \quad (8)$$

3.8
standardized impact sound pressure level L'_{nT}

impact sound pressure level L_i reduced by the reverberation index k, and expressed in decibels:

$$L'_{nT} = L_i - k \text{ dB} \quad (9)$$

3.9
normalized impact sound pressure level L'_n

impact sound pressure level L_i reduced by a correction term which is given in decibels, being ten times the logarithm to the base 10 of the ratio between the reference equivalent absorption area and the actual equivalent sound absorption area A of the receiving room. The actual equivalent absorption area is calculated from the reverberation index, the reference reverberation time and the room volume:

$$L'_n = L_i - 10 \lg \frac{A_0}{A} \text{ dB} = L_i - k - 10 \lg \frac{A_0 \, T_0}{0{,}16 \, V} \text{ dB} \quad (10)$$

where

V is the volume of the receiving room in cubic metres;

k is the reverberation index;

T_0 is the reference reverberation time (T_0 = 0,5 s);

A_0 is the reference absorption area (A_0 = 10 m^2);

0,16 has the unit s/m

3.10
average sound pressure level on a test surface $L_{1,s}$
ten times the logarithm to the base 10 of the ratio of the surface and time average of the sound pressure squared to the square of the reference sound pressure, the surface average being taken over the entire test surface including reflecting effects from the test specimen and façade; it is expressed in decibels

3.11
façade level difference D_{2m}
difference between the outdoor sound pressure level 2 m in front of the façade, $L_{1;2m}$, and the space and time averaged sound pressure level, L_2, in the receiving room. It is expressed in decibels as:

$$D_{2m} = L_{1,2m} - L_2 \quad \text{dB} \tag{11}$$

It is also possible to measure in the plane of the façade. In this case the denotation is $L_{1,s}$ instead of $L_{1;2m}$.

If road traffic sound has been used as sound source the notation is $D_{tr,2m}$ and if a loudspeaker has been used it is $D_{ls,2m}$ and is expressed in decibels

3.12
standardized façade level difference $D_{2m,nT}$
façade level difference D_{2m} corresponding to a reference value of the reverberation time in the receiving room. It is expressed in decibels as

$$D_{2m,nT} = D_{2m} + k \quad \text{dB} \tag{12}$$

where

k is the reverberation index

3.13
normalized façade level difference $D_{2m,n}$
façade level difference D_{2m} corresponding to the reference equivalent absorption area in the receiving room:

$$D_{2m,n} = D_{2m} + k + 10 \lg \frac{A_0 T_0}{0{,}16\, V} \text{ dB} \tag{13}$$

where

V is the volume of the receiving room in cubic metres;

k is the reverberation index;

T_0 is the reference reverberation time (T_0 = 0,5 s);

A_0 is the reference equivalent absorption area in square metres (A_0 = 10 m^2);

0,16 has the unit s/m

3.14
service equipment sound pressure level
the average sound pressure level in the room obtained by the procedure described in 6.3.3 indexes 1 and 2 relate to the position of the measuring points

$$L_{XY} = 10\lg\left(\frac{1}{3}\times 10^{L_{XY,1}/10} + \frac{2}{3}\times 10^{L_{XY,2}/10}\right) \text{ dB} \tag{14}$$

where

$L_{XY,i}$ is the weighted sound pressure level at position 1 being the corner position

$L_{xy,2}$ is the weighted sound pressure level measured at the position 2 being in the reverberant field of the room.

Index x relates to frequency weighting used (x = A or C).

- Index y characterizes there the temporal weighting (y = F, S or equivalent continuous level L_{eq})

NOTE The different measures L_{XY} are not comparable. Only measurement results obtained with the same measuring parameters should be compared

3.15
standardized service equipment sound pressure level
sound pressure level corresponding to a reference of the reverberation time in the receiving room. This quantity is denoted by $L_{XY,nT}$

$$L_{XY,nT} = L_{XY} - k \quad \text{dB} \tag{15}$$

where

L_{XY} is the service equipment sound pressure level;

k is the reverberation index

in this case, k is calculated from the arithmetic average of the reverberation times measured for the octave-bands 500Hz, 1kHz and 2kHz.
K = 10lg 1/3 [(T_{500} + T_{1000} + T_{2000})/T_0]

3.16
normalized service equipment sound pressure level
service equipment sound pressure level corresponding to the reference equivalent absorption area in the receiving room. This quantity is denoted by $L_{XY,n}$

$$L_{XY,n} = L_{XY} - k - 10\lg\frac{A_0\ T_0}{0{,}16\ V} \text{ dB} \tag{16}$$

where

L_{XY} is the service equipment sound pressure level;