INTERNATIONAL STANDARD

ISO 10848-3

First edition
2006-04-01

Acoustics — Laboratory measurement of the flanking transmission of airborne and impact sound between adjoining rooms —

Part 3: Application to light elements when the junction has a substantial influence

Acoustique — Mesurage en laboratoire des transmissions latérales du bruit aérien et des bruits de choc entre des pièces adjacentes —

Partie 3: Application aux éléments légers lorsque la jonction a une influence importante

Reference number
ISO 10848-3:2006(E)

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Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10848-3 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 126, *Acoustic properties of building elements and of buildings*, 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).

ISO 10848 consists of the following parts, under the general title *Acoustics — Laboratory measurement of the flanking transmission of airborne and impact sound between adjoining rooms*:

— *Part 1: Frame document*

— *Part 2: Application to light elements when the junction has a small influence*

— *Part 3: Application to light elements when the junction has a substantial influence*

The following part is under preparation:

— Part 4: *Application to all other cases*

Acoustics — Laboratory measurement of the flanking transmission of airborne and impact sound between adjoining rooms —

Part 3: Application to light elements when the junction has a substantial influence

1 Scope

ISO 10848 specifies measurement methods to be performed in a laboratory test facility in order to characterize the flanking transmission of one or several building components.

The measured quantities can be used to compare different products, or to express a requirement, or as input data for prediction methods, such as EN 12354-1 and EN 12354-2.

This part of ISO 10848 is specifically referred to in ISO 10848-1:2006, 4.4, as being a supporting part to the frame document.

This part of ISO 10848 applies to structurally connected light elements forming a T or X junction. A light element is defined in ISO 10848-1:2006, Clause 3.

The relevant quantity to be measured is selected according to ISO 10848-1:2006, 4.4. The performance of the building components is expressed either as an overall quantity for the combination of elements and junction (such as $D_{\mathrm{n,f}}$ and/or $L_{\mathrm{n,f}}$) or as the vibration reduction index K_{ij} of a junction. $D_{\mathrm{n,f}}$ and $L_{\mathrm{n,f}}$ depend on the actual dimensions of the elements, while K_{ij} is in principle an invariant quantity.

For general application of the test results, $D_{\mathrm{n,f}}$ and $L_{\mathrm{n,f}}$ are the relevant quantities to measure for lightweight, well-damped types of elements (for example, timber or metal framed stud walls or wooden floors on beams), where the actual situation has no real influence on the sound reduction index and damping of the elements. If the acoustical properties of the elements are substantially influenced by the actual situation, K_{ij} is the relevant quantity to measure.

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.

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

ISO 140-3:1995, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 3: Laboratory measurements of airborne sound insulation of building elements*

ISO 140-6:1998, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 6: Laboratory measurements of impact sound insulation of floors*

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

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

ISO 10848-1:2006, *Acoustics — Laboratory measurement of the flanking transmission of airborne and impact sound between adjoining rooms — Part 1: Frame document*

3 Terms and definitions

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

3.1
normalized flanking level difference
$D_{n,f}$
difference in the space and time average sound pressure level produced in two rooms by one or more sound sources in one of them, when the transmission only occurs through a specified flanking path

NOTE $D_{n,f}$ is normalized to an equivalent sound absorption area (A_0) in the receiving room and expressed, in decibels:

$$D_{n,f} = L_1 - L_2 - 10 \lg \frac{A}{A_0} \text{ dB} \quad (1)$$

where

L_1 is the average sound pressure level in the source room, in decibels;

L_2 is the average sound pressure level in the receiving room, in decibels;

A is the equivalent sound absorption area in the receiving room, in square metres;

A_0 is the reference equivalent sound absorption area, in square metres; A_0 = 10 m^2.

[ISO 10848-1:2006]

3.2
normalized flanking impact sound pressure level
$L_{n,f}$
space and time average sound pressure level in the receiving room produced by a standard tapping machine operating at different positions on a tested floor in the source room, when the transmission only occurs through a specified flanking path

NOTE $L_{n,f}$ is normalized to an equivalent sound absorption area (A_0) in the receiving room and is expressed in decibels:

$$L_{n,f} = L_2 + 10 \lg \frac{A}{A_0} \text{ dB} \quad (2)$$

where

L_2 is the average sound pressure level in the receiving room, in decibels;

A is the equivalent sound absorption area in the receiving room, in square metres;

A_0 is the reference equivalent sound absorption area, in square metres; A_0 = 10 m^2.

[ISO 10848-1:2006]

3.3
vibration reduction index
K_{ij}
value given by the following equation and expressed in decibels:

$$K_{ij} = \overline{D_{v,ij}} + 10 \lg \frac{l_{ij}}{\sqrt{a_i a_j}} \text{ dB} \quad (3)$$

where

$\overline{D_{v,ij}}$ is the direction-averaged velocity level difference between elements i and j, in decibels;

l_{ij} is the junction length between elements i and j, in metres;

a_i, a_j are the equivalent absorption lengths of elements i and j, in metres.

NOTE 1 The equivalent absorption length depends on the structural reverberation time as defined in ISO 10848-1:2006, 3.8. For lightweight, well-damped types of elements where the actual situation has no real influence on the sound reduction index and damping of an element, a_j is taken as numerically equal to the surface area S_j of the element, $a_j = S_j/l_0$, where the reference length l_0 = 1 m.

NOTE 2 The vibration reduction index is related to the vibrational power transmission over a junction between structural elements, normalized in order to make it an invariant quantity.

4 Measuring equipment

The equipment shall fulfil the requirements given in ISO 10848-1:2006, Clause 5.

5 Test arrangement

5.1 Requirements for the laboratory

The general requirements for test specimens and test rooms given in ISO 10848-1:2006, Clause 6 shall be fulfilled.

For measurements of the vibration reduction index K_{ij} with structure-borne excitation, it is not necessary to have an envelope forming a source and receiving room around the junction. A test object with a vertical junction line may be placed directly onto a heavy concrete floor fulfilling the condition expressed in ISO 10848-1:2006, 8.2.

The situation is a little more complicated for horizontal junctions, since stability shall be provided. In most situations, it is necessary to use the same type of test facility for all types of measurement, with the exception that the requirements for the airborne sound insulation between the volumes do not apply for measurements of K_{ij} with structure-borne excitation.

5.2 Installation of the test junction

Because the behaviour of light elements is not influenced significantly by the boundary conditions, it is not compulsory to use realistic construction techniques at the boundaries of the test element with the test facility. When the test facility is made of heavy concrete, the test element may be mounted according to common practice, or according to the manufacturer's instructions.

In order to prevent unwanted transmission of vibrations between the test elements and a light envelope, a soft resilient material shall be used at junctions between the test junction elements and the light envelope.

If there is any doubt about a possible flanking transmission through junctions other than the junction under test, the verification specified in ISO 10848-1:2006, 8.1.1 shall be carried out.

If the test junction is just placed on the floor, without any supporting structure, the edges may generally be left free.

5.3 Shielding technique

Shielding shall be considered if airborne excitation is used, or the sound pressure level is measured on the receiving side of the junction as a part of the test. Shielding is specified in ISO 10848-1:2006, Clause 9.

6 Test procedures

Measurements of $D_{n,f}$ and $L_{n,f}$ are performed as specified in ISO 10848-1:2006, 7.1 with airborne excitation or with a standardised tapping machine.

Measurements of K_{ij} are performed as specified in ISO 10848-1:2006, 7.2 (structure-borne excitation) or ISO 10848-1:2006, 7.4 (airborne excitation). The relevance of the test results is evaluated according to ISO 10848-1:2006, 4.3.4.

The frequency range is given in ISO 10848-1:2006, 7.5.

7 Precision

It is required that the measurement procedure give satisfactory repeatability. This is determined in accordance with the method shown in ISO 140-2 and shall be verified from time to time, particularly when a change is made in the procedure or instrumentation.

It is recommended that different organisations should periodically perform comparison measurements on the same test specimen to check repeatability and reproducibility of their test procedures.

8 Expression of results

For the statement of the normalized flanking level difference $D_{n,f}$ or the normalized flanking impact sound pressure level $L_{n,f}$ or the vibration reduction index K_{ij}, the results shall be given at all frequencies of measurement to one decimal place in tabular form and in the form of a curve.

Graphs in the test report shall show the value in decibels plotted against frequency on a logarithmic scale, using the following dimensions:

— 5 mm for one-third octave;

— 20 mm for 10 dB.

The use of a form in accordance with Annex G of ISO 140-3:1995 or Annex E of ISO 140-6:1998 is recommended. Being a short version of the test report, all information of importance regarding the test object, the test procedure and the test results shall be stated.

If results are needed in octave-bands, these values shall be calculated from the three one-third-octave-band values in each octave-band using one of the following equations:

$$D_{\text{n,f,oct}} = -10 \ \lg \left(\frac{1}{3} \sum_{n=1}^{3} 10^{-D_{\text{n,f,1/3oct.}n}/10} \right) \ \text{dB} \tag{4}$$

$$L_{\text{n,f,oct}} = 10 \ \lg \left(\sum_{n=1}^{3} 10^{L_{\text{n,f,1/3oct.}n}/10} \right) \ \text{dB} \tag{5}$$

$$K_{ij,\text{oct}} = -10 \ \lg \left(\frac{1}{3} \sum_{n=1}^{3} 10^{-K_{ij,\text{1/3oct.}n}/10} \right) \ \text{dB} \tag{6}$$

If $D_{\text{n,f}}$ or $L_{\text{n,f}}$ is measured and the test procedure is repeated either in the same or in the opposite measurement direction, the arithmetic mean of all measurement results at each frequency band shall be calculated.

For measurements of $L_{\text{n,f}}$, the larger room is always the receiving room.

For the evaluation of single number ratings from the curves $D_{\text{n,f}}(f)$ and/or $L_{\text{n,f}}(f)$, see ISO 717-1 and ISO 717-2, respectively. The quantities obtained are the weighted normalized flanking level difference $D_{\text{n,f,w}}(C;\ C_{\text{tr}})$ and the weighted normalized flanking impact sound pressure level $L_{\text{n,f,w}}(C_{\text{I}})$.

For the evaluation of single number rating from the curve $K_{ij}(f)$ see Annex A of ISO 10848-1:2006.

9 Test report

The test report shall include the following information:

a) a reference to this part of ISO 10848, i.e. “ISO 10848-3”;

b) the name of the organisation that has performed the measurements;

c) an identification of the test site;

d) the date of test;

e) the name of client;

f) the manufacturer’s name and product identification;

g) a description of test junction with sectional drawing and mounting conditions, including size, thickness, mass per unit area, materials, curing time and conditions of components (if available); statement indicating who mounted the test object (test institute or manufacturer);

h) a description of which transmission paths i, j have been investigated;

i) the volumes of both reverberant rooms if any;

j) the air temperature and humidity in the measuring rooms or environments of the junction;

k) a brief description of details of test procedure and equipment;

If $D_{\text{n,f}}$ and/or $L_{\text{n,f}}$ have been measured:

l) normalized flanking level difference and/or normalized flanking impact sound pressure level of the test junction as a function of frequency;

m) indication of results which are to be taken as limits of measurement;

They shall be given as $D_{n,f} \geqslant$ ... dB or $L_{n,f} \leqslant$ ... dB. This shall be applied if the sound pressure level in any band is not measurable on account of background noise (acoustic or electrical) and also if the measured value has been affected by sound transmission through the constructions of the test facility.

If K_{ij} has been measured:

n) vibration reduction index and direction-averaged velocity level difference as a function of frequency;

o) type of excitation (stationary structure-borne, transient structure-borne or airborne);

p) structural reverberation time if measured;

q) information about whether the equivalent absorption length has been determined from the measured structural reverberation time or from the surface area;

r) possible limitations of the relevance of K_{ij} in case the vibration fields of the elements are not reverberant;

s) indication of results which are to be taken as limits of measurement.

They shall be given as $K_{ij} \geqslant$ ... dB. This shall be applied if the velocity level in any band is not measurable on account of background noise (vibrational or electrical), and also if the measured value has been affected by transmission through other junctions with the constructions of the test facility.

Annex A
(informative)

Measurement of $D_{n,f,I}$ and $L_{n,f,I}$ with intensity technique

Because the requirement for shielding in the receiving room does not apply, measuring the radiated sound from element j with the intensity technique should be considered. A suitable procedure for the intensity measurement is given in ISO 15186-2 [1].

The intensity normalized flanking level difference $D_{n,f,I}$ is determined with airborne excitation in the source room from:

$$D_{n,f,I} = \left[L_{p1} - 6 \right] - \left[\overline{L}_{I_n,j} + 10 \lg \left(\frac{S_{m,j}}{A_0} \right) \right] \text{ dB} \qquad \text{(A.1)}$$

where

L_{p1} is the average sound pressure level in the source room;

$\overline{L}_{I_n,j}$ is the average normal sound intensity level over the measurement surface enclosing element j in the receiving room;

$S_{m,j}$ is the total area of the measurement surface enclosing element j in the receiving room;

A_0 is the reference equivalent sound absorption area, in square metres; $A_0 = 10 \text{ m}^2$.

The intensity normalized flanking impact sound pressure level $L_{n,f,I}$ is determined with excitation by the standard tapping machine from:

$$L_{n,f,I} = 6 + \left[\overline{L}_{I_n,j} + 10 \lg \left(\frac{S_{m,j}}{A_0} \right) \right] \text{ dB} \qquad \text{(A.2)}$$

The requirements for the loudspeaker, noise, standard tapping machine, source positions and sound pressure measurements in the source room are the same as in the main text of this standard. Specifications for the intensity measurements are given in ISO 15186-2 (instrumentation, qualification of measurement surface, measurement of average sound intensity level, etc.).

Bibliography

[1] ISO 15186-2, *Acoustics — Measurement of sound insulation in buildings and of building elements using sound intensity — Part 2: Field measurements*

[2] EN 12354-1, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 1: Airborne sound insulation between rooms*

[3] EN 12354-2, *Building acoustics — Estimation of acoustic performance of buildings from the performance of elements — Part 2: Impact sound insulation between rooms*

ICS 91.120.20

Price based on 8 pages