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Acoustics — Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms —

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

Acoustique — Mesurage en laboratoire et sur le terrain des transmissions latérales du bruit aérien, des bruits de choc et du bruit d'équipement technique de bâtiment entre des pièces —

Partie 3: Application aux éléments de Type B lorsque la jonction a une influence importante

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

This second edition cancels and replaces the first edition (ISO 10848-3:2006), which has been technically revised with the following changes:

a) extension to field measurements;

b) extension to building service equipment with the introduction of the normalized flanking equipment sound pressure level;

c) normalized direction-averaged vibration level difference for junctions between lightweight elements has been introduced.

A list of all the parts in the ISO 10848 series can be found on the ISO website.

Acoustics — Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms —

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

1 Scope

ISO 10848 (all parts) specifies measurement methods to characterize the flanking transmission of one or several building components.

This document specifies laboratory and field measurements of buildings for Type B elements (defined in ISO 10848-1) when the junction has a substantial influence.

Laboratory measurements are used to quantify the performance of the junction with suppressed flanking transmission from the laboratory structure. Field measurements are used to characterize the *in situ* performance and it is not usually possible to suppress unwanted flanking transmission sufficiently; hence, the results can only be considered representative of the performance of that junction when installed in that particular building structure.

This document is referred to in ISO 10848-1:2017, 4.5 as being a supporting part to the frame document and applies to Type B elements that are structurally connected as defined in ISO 10848-1.

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

The relevant quantity to be measured is selected according to ISO 10848-1:2017, 4.5. The performance of the building components is expressed either as an overall quantity for the combination of elements and junction (such as $D_{n,f,ij}$ and/or $L_{n,f,ij}$ and/or $L_{ne0,f,ij}$) or as the normalized direction-average velocity level difference $\overline{D_{v,ij,n}}$ of a junction. $D_{n,f,ij}$, $L_{n,f,ij}$, $L_{ne0,f,ij}$ and $\overline{D_{v,ij,n}}$ depend on the actual dimensions of the elements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 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 10848-1:2017, *Acoustics — Laboratory and field measurement of flanking transmission for airborne, impact and building service equipment sound between adjoining rooms — Part 1: Frame document*

ISO 12999-1, *Acoustics — Determination and application of measurement uncertainties in building acoustics — Part 1: Sound insulation*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
normalized flanking level difference
$D_{n,f}$
difference in the space and time averaged 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 and the result is normalized to an equivalent sound absorption area in the receiving room according to

$$D_{n,f} = L_1 - L_2 - 10\lg\frac{A}{A_0}$$

where

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

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

A is the equivalent sound absorption area in the receiving room, in m^2;

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

Note 1 to entry: This quantity is expressed in decibels.

Note 2 to entry: For clarity, the term $D_{n,f}$ is used when only one flanking path determines the sound transmission (such as with suspended ceilings) and the term $D_{n,f,ij}$ is used when only one specified transmission path *ij* out of several paths is considered (such as with structure-borne sound transmission on junctions of three or four connected elements).

3.2
normalized flanking impact sound pressure level
$L_{n,f}$
space and time averaged sound pressure level in the receiving room produced by a tapping machine operating at different positions on a tested element (floor) in the source room, when the transmission only occurs through a specified flanking path and the result is normalized to an equivalent sound absorption area, in the receiving room according to

$$L_{n,f} = L_2 + 10\lg\frac{A}{A_0}$$

where

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

A is the equivalent sound absorption area in the receiving room, in m^2;

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

Note 1 to entry: This quantity is expressed in decibels.

Note 2 to entry: For clarity, the term $L_{n,f}$ is used when only one flanking path determines the sound transmission (such as with access floors) and the term $L_{n,f,ij}$ is used when only one specified transmission path *ij* out of several paths is considered (such as with structure-borne sound transmission on junctions of three or four connected elements).

3.3
normalized flanking equipment sound pressure level
$L_{ne0,f}$
space and time averaged sound pressure level in the receiving room produced by a structure-borne sound source injecting a unit power (1 W) at different positions on a tested element in the source room, when the transmission only occurs through a specified flanking path and the result is normalized to an equivalent sound absorption area in the receiving room and is expressed in decibels according to

$$L_{ne0,f} = L_{2e} + 10\lg\frac{A}{A_0}$$

where

L_{2e} is the average sound pressure level in the receiving room with a structure-borne sound source injecting 1 W into the tested element, in dB;

A is the equivalent sound absorption area in the receiving room, in m^2;

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

Note 1 to entry: This quantity is expressed in decibels.

Note 2 to entry: For clarity, the term $L_{ne0,f}$ is used when only one flanking path determines the sound transmission (such as with equipment installed on access floors or light façades) and the term $L_{ne0,f,ij}$ is used when only one specified transmission path ij out of several paths is considered (such as with structure-borne sound transmission on junctions of three or four connected elements).

3.4
normalized direction-average vibration level difference
$\overline{D_{v,ij,n}}$
difference in velocity level between elements i and j, averaged over the excitation from i and excitation from j, and normalized to the junction length and the measurement areas on both elements according to

$$\overline{D_{v,ij,n}} = \overline{D_{v,ij}} + 10\lg\left(\frac{l_{ij}\,l_0}{\sqrt{S_{m,i}\,S_{m,j}}}\right)$$

where

l_0 is the reference length, in m; $l_0 = 1$ m;

$S_{m,i}$ is the area of element i over which the velocity is measured, in m^2;

$S_{m,j}$ is the area of element j over which the velocity is measured, in m^2.

Note 1 to entry: This quantity is expressed in decibels.

4 Instrumentation

The equipment shall fulfil the requirements of ISO 10848-1:2017, Clause 5.

5 Test arrangement

5.1 Requirements for the laboratory

The general requirements for the test facility shall be fulfilled according to ISO 10848-1:2017, 6.1.

For measurements of the normalized direction-average vibration level difference 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 concrete floor fulfilling the condition according to ISO 10848-1:2017, 8.3.

The situation is a more complicated for horizontal junctions, since structural 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 the normalized direction-average velocity level difference with structure-borne excitation.

5.2 Requirements for a building structure in the field situation

The requirements on the test facility and test elements for laboratory measurements in ISO 10848-1:2017, 6.1 can be used as a guide for field measurements. However, it will not usually be possible to satisfy them in the field; hence, the connected building structure shall be described in the test report.

For measurements requiring sound pressure levels in rooms, the room volumes shall be at least 25 m^3.

5.3 Installation of the test junction

Because the behaviour of Type B 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 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 an envelope with a low mass per unit area, a soft resilient material shall be used at junctions between the test junction elements and the envelope.

If there is any doubt about a possible flanking transmission through junctions other than the junction under test, the verification shall be carried out as described in ISO 10848-1:2017, Clause 8.

If the test junction is placed on the floor without any supporting structure, the top and side edges may be left unconnected.

5.4 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 10848-1:2017, Clause 9.

6 Test procedures

The frequency range for measurements is given in ISO 10848-1:2017, 7.4.

Measurements of $D_{n,f,ij}$, $L_{n,f,ij}$ and $L_{ne0,f,ij}$ shall be carried out as described in ISO 10848-1:2017, 7.1 with airborne excitation, a standardised tapping machine or a calibrated structure-borne sound source.

Measurements of $\overline{D_{v,ij,n}}$ shall be performed as described in ISO 10848-1:2017, 7.2 with structure-borne excitation.

If the requirement for shielding in the receiving room does not apply, measurement of the radiated sound from element j with the intensity technique should be considered (see Annex A).

7 Precision

The measurement procedure shall give satisfactory repeatability. This is determined in accordance with the method described in ISO 12999-1 and shall be verified from time to time, particularly when a change is made in the procedure or instrumentation.

Different organizations 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 $D_{n,f,ij}$ and/or the normalized flanking impact sound pressure level $L_{n,f,ij}$ and/or the normalized direction-averaged velocity level difference $\overline{D_{v,ij,n}}$ and/or the normalized flanking equipment sound pressure level $L_{ne0,f,ij}$, 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 ISO 10140-2:2010, Annex B or ISO 10140-3:2010, Annex B 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 Formulae (1), (2), (3) or (4):

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

$$L_{n,f,ij,oct} = 10\lg\left(\sum_{n=1}^{3}10^{L_{n,f,ij,1/3oct.n}/10}\right) \quad (2)$$

$$\overline{D_{v,ij,oct}} = -10\lg\left(\frac{1}{3}\sum_{n=1}^{3}10^{-\overline{D_{v,ij,1/3oct.n}}/10}\right) \quad (3)$$

$$L_{ne0,f,ij,oct} = 10\lg\left(\sum_{n=1}^{3}10^{L_{ne0,f,ij,1/3oct.n}/10}\right) \quad (4)$$

If $D_{n,f,ij}$, $L_{n,f,ij}$ or $L_{ne0,f,ij}$ 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 $L_{n,f,ij}$ and $L_{ne0,f,ij}$, the larger room is always the receiving room.

The evaluation of single-number ratings from $D_{n,f,ij}$ and $L_{n,f,ij}$ shall be in accordance with ISO 717-1 and ISO 717-2, respectively. The quantities obtained are the weighted normalized flanking level difference $D_{n,f,ij,w}(C;C_{tr})$ and the weighted normalized flanking impact sound pressure level $L_{n,f,ij,w}(C_I)$.

The evaluation of single-number rating for $\overline{D_{v,ij,n}}$ shall be in accordance with ISO 10848-1:2017, Clause 10.

9 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 10848-3:2017;

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

c) an identification of the test site as laboratory (including name and address of the testing laboratory) or field;

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);

h) a statement indicating who mounted the laboratory test object (test institute or manufacturer);

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

j) the volumes of both reverberant rooms, if any;

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

l) a brief description of test procedures and equipment, including any deviations from the procedures and any unusual features observed;

m) if $\overline{D_{\mathrm{v},ij,\mathrm{n}}}$ has been measured, the type of excitation (stationary or transient structure-borne) and structural reverberation times, if measured;

n) the normalized flanking level difference and/or normalized flanking impact sound pressure level and/or direction-averaged velocity level difference and/or normalized flanking equipment sound pressure level of the test junction as a function of frequency;

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

They shall be given as $D_{\mathrm{n,f},ij} \geq \ldots$ dB or $L_{\mathrm{n,f},ij} \leq \ldots$ dB. or $L_{\mathrm{ne0,f},ij} \leq \ldots$ 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;

p) single-number quantities: for $D_{\mathrm{n,f},ij}$ and/or $L_{\mathrm{n,f},ij}$, which are the weighted normalized flanking level difference $D_{\mathrm{n,f},ij,\mathrm{w}}(C;C_{\mathrm{tr}})$ and/or the weighted normalized flanking impact sound pressure level $L_{\mathrm{n,f},ij,\mathrm{w}}(C_{\mathrm{I}})$ and for $\overline{D_{\mathrm{v},ij,\mathrm{n}}}$ use the direction-averaged velocity level difference single-number quantity for each of the low-frequency, mid-frequency, and high-frequency ranges defined in ISO 10848-1:2017, Clause 10;

q) an indication of results which are to be taken as limits of measurement. They shall be given as $D_{\mathrm{n,f}} \geq \ldots$ dB or $L_{\mathrm{n,f}} \leq \ldots$ dB, or $L_{\mathrm{ne0,f}} \leq \ldots$ dB or $\overline{D_{\mathrm{v},ij,\mathrm{n}}} \geq \ldots$ dB. This shall be applied if the level in any band in/on the receiving room/element 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 $D_{n,f,ij,I}$ and $L_{n,f,ij,I}$ and $L_{ne0,f,ij,I}$ with sound intensity

If the requirement for shielding in the receiving room does not apply, measurement of 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.

The intensity normalized flanking level difference $D_{n,f,ij,I}$ is determined with airborne excitation in the source room from Formula (A.1):

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

where

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

$\bar{L}_{I_{n,j}}$ 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 m^2; $A_0 = 10\ m^2$.

The intensity normalized flanking impact sound pressure level $L_{n,f,ij,I}$ is determined with excitation by the standard tapping machine from Formula (A.2):

$$L_{n,f,ij,I} = 6 + \left[\bar{L}_{I_{n,j}} + 10\lg\left(\frac{S_{m,j}}{A_0}\right)\right] \quad \text{(A.2)}$$

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 document. Specifications for the intensity measurements are given in ISO 15186-2 (instrumentation, qualification of measurement surface, measurement of average sound intensity level, etc.).

The intensity normalized flanking equipment sound pressure level $L_{n,f,ij,I}$ is determined with excitation by the structure-borne sound source from Formula (A.3):

$$L_{ne0,f,ij,I} = 6 + \left[\bar{L}_{I_{n,j}} + 10\lg\left(\frac{S_{m,j}}{A_0}\right)\right] \quad \text{(A.3)}$$