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Acoustics — Measurement of sound insulation in buildings and of building elements —

Part 16:

Laboratory measurement of the sound reduction index improvement by additional lining

Acoustique — Mesurage de l'isolation acoustique des immeubles et des éléments de construction —

Partie 16: Mesurage en laboratoire de l'amélioration de l'indice de réduction acoustique par un revêtement complémentaire

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ISO/CEN PARALLEL ENQUIRY

This draft International Standard is a draft standard developed within the European Committee for Standardization (CEN) and processed under the CEN-lead mode of collaboration as defined in the Vienna Agreement. The document has been transmitted by CEN to ISO for circulation for ISO member body voting in parallel with CEN enquiry. Comments received from ISO member bodies, including those from non-CEN members, will be considered by the appropriate CEN technical body. Should this DIS be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

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Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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Foreword

This document prEN ISO 140-16:2003 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 document is currently submitted to the parallel Enquiry.

ISO 140 consists of the following parts, under the general title *Acoustics — Measurement of sound insulation in buildings and of building elements*:

— *Part 1: Requirements for laboratory test facilities with suppressed flanking transmission;*

— *Part 2: Determination, verification and application of precision data;*

— *Part 3: Laboratory measurements of airborne sound insulation of building elements;*

— *Part 4: Field measurements of airborne sound insulation between rooms;*

— *Part 5: Field measurements of airborne sound insulation of façade elements and façades;*

— *Part 6: Laboratory measurements of impact sound insulation of floors;*

— *Part 7: Field measurements of impact sound insulation of floors;*

— *Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a solid standard floor;*

— *Part 9: Laboratory measurements of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it;*

— *Part 10: Laboratory measurement of airborne sound insulation of small building elements;*

— *Part 11: Measurement of impact sound improvement of light-weight floors;*

— *Part 12: Laboratory measurement of room-to-room airborne and impact sound insulation of an access floor;*

— *Part 13: Guidelines;*

— *Part 14: Additional requirements and guidelines for sound insulation measurements according to ISO 140-4 and ISO 140-7 - Special situations in the field,*

— *Part 16: Laboratory measurement of the sound reduction improvement by acoustical linings;*

— *Part 17: Evaluation of the total loss factor;*

— *Part 18: Laboratory measurement of sound generated by rainfall on building elements.*

Introduction

There is a strong need to separately characterise the sound reduction effect of walls or floors and acoustic linings. On the one hand different industries are involved. On the other hand the European calculation model for the acoustic performance of buildings from the performance of elements distinguishes the sound reduction index of a wall (or floor) and the improvement of the sound reduction index by an additional lining. The laboratory measurement of this sound reduction improvement is the subject of this standard.

Characterising a lining alone requires that its acoustic performance is independent from the basic structure to which it is fixed. This is fulfilled when the mass per unit area of the basic structure is much larger than the surface mass of the lining, when the coincidence frequency of the basic structure is below the measured frequency range and the structural coupling between the lining and the basic structure is small. If the actual situation differs from these conditions, the effect of the lining is, at least to some extent, dependent on the properties of the basic structure. The independent characterisation of the acoustic performance of a lining thus requires very heavy massive elements, while a lot of practical applications will involve various lightweight elements. As a practical compromise, different steps of testing are provided:

- In any case, the lining is to be applied to either a heavy massive wall of about 350 kg/m² with its coincidence frequency around 125 Hz or to the standard concrete floor according to EN ISO 140-8, depending on the use of the lining. The measured improvement by the lining is given as a frequency spectrum and as a single number improvement value according Annexes A and B. Being based on mean basic element characteristics, the results are largely independent of the particular features of the test facility and the basic element used and thus characterise the lining in the most general way.

- If the performance of a lining on a generalized lightweight solid wall is of interest, a standard lightweight basic wall of about 70 kg/m² and coincidence around 500 Hz has to be used. The results are to be given as a frequency spectrum and as a single number improvement value according Annexes A and B. The central position of the coincidence frequency may strongly influence the improvement by the lining. Therefore the results are not likely to be transferable to other basic constructions. But using the weighting procedure in Annexes A and B, the influences of the particular test facility and basic construction are minimized, thus making the results comparable between different laboratories.

- In order to specify the effect of linings in specific situations, other basic structures can be used in addition to those specified for the general characterisation of the product. As no mean properties of the basic element are available in this case, single number results can only be given in terms of the direct difference between the weighted sound reduction indices with and without lining (subsequently called 'direct difference of the weighted sound reduction indices'). These improvement values include the particular features of the laboratory and the basic element, thus allowing a comparison of different linings under these particular conditions.

Flexible lightweight basic elements and elements with thickness resonances within the measured frequency range are outside the scope of this standard as their influence is not predictable.

For standardisation reasons and comparability, all measurements and evaluations are normatively done in third octave bands. Additional octave band results can optionally be deduced from the third octave band results.

The sound reduction improvement of a lining may be different for direct and flanking sound transmission as well as for airborne and impact sound excitation. The method described in this standard yields the sound reduction improvement for direct airborne sound transmission.

1 Scope

This draft standard is a complement to EN ISO 140-3 and specifies the laboratory measurement of the improvement of the sound reduction index of a wall or ceiling, when covered by an additional acoustical lining. Dependent on the application of the lining, the tests are carried out on a massive heavyweight wall or floor with its coincidence frequency near 125 Hz and without any abnormalities concerning its airborne sound transmission (like thickness resonances). The results, including the single number improvement values, can be used to compare and predict the acoustic performance of additional linings, when combined with walls or ceilings meeting the above mentioned conditions of low coincidence frequency and absence of abnormalities and having a mass per unit area at least ten times larger than that of the lining.

As additional linings are often applied to more lightweight homogeneous massive walls, another basic wall is defined with a given coincidence frequency around 500 Hz. As a strong interaction of lining and wall is expected in this case, the results, including the single number improvement values, are limited to this type of basic walland may thus be mainly used to compare and estimate the acoustic performance of linings under similar conditions.

If individual, non-standardised basic elements are used, the only way to state a single number result is to calculate the direct difference of the weighted sound reduction indices of the basic element with and without lining. This value depends on the features of the test facility and of the basic element and thus mainly allows a comparison of different linings under the same measuring conditions.

This draft standard does not deal with the sound reduction improvement by linings on flexible lightweight structures such as timber frame floors or double leaf gypsum board walls.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN ISO 140-1, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 1: Requirements for laboratory test facilities with suppressed flanking transmission.*

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

EN ISO 140-8:1997, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 8: Laboratory measurements of the reduction of impact sound insulation of building elements.*

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

EN ISO 140-1:1997/prA1:2002, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 1: Requirements for laboratory test facilities with suppressed flanking transmission, Amendment 1: Specific requirements on the frame of the test opening for leightweight double partitions to avoid strong couplings between leaves (ISO 140-1:1997/DAM 1:2002)*

3 Terms and definitions

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

3.1
sound reduction index
R
see EN ISO 140-3

3.2
weighted sound reduction index
R_w
see EN ISO 717-1

3.3
sound reduction improvement index
ΔR
difference of the sound reduction indices of the basic element with and without the lining for each third octave band:

$$\Delta R = R_{with} - R_{without} \quad (1)$$

3.4
weighted sound reduction improvement index
ΔR_w
single number value calculated from the sound reduction improvement index ΔR according to Annexes A and B. An additional index indicates the basic element used: 'heavy' for the heavyweight wall and floor according to clause 4.3.2. resp. 4.3.3, 'light' for the lightweight wall according to clause 4.3.4. Example: $\Delta R_{w,heavy}$

3.5
direct difference of the weighted sound reduction indices
$\Delta R_{w,direct}$
difference of the weighted sound reduction indices of the basic element with and without lining:

$$\Delta R_{w,direct} = R_{w,with} - R_{w,without}$$

3.6
A-weighted sound reduction improvement indices
$\Delta(R_w+C)$ **resp.** $\Delta(R_w+C_{tr})$
A-level difference caused by the lining when the exciting sound source sends pink noise (C) or standardised traffic noise (C_{tr}). C and C_{tr} are the spectrum adaptation terms according to ISO 717-1. For calculation see Annex A. An additional index indicates the basic element used: 'heavy' for the heavyweight wall and floor according to clause 4.3.2. resp. 4.3.3, 'light' for the lightweight wall according to clause 4.3.4. Example: $\Delta(R_w+C)_{heavy}$

3.7
direct difference of the A-weighted sound reduction indices
$\Delta(R_w+C)_{direct}$ **resp.** $\Delta(R_w+C_{tr})_{direct}$
difference of the A-weighted sound reduction indices of the basic element with and without lining under the particular conditions of the measurement (without generalization by means of a reference curve for the sound reduction of the basic element) and noise source characteristics:

$$\Delta(R_w + C)_{direct} = (R_{w,with} + C_{with}) - (R_{w,without} + C_{without})$$

$$\Delta(R_w + C_{tr})_{direct} = (R_{w,with} + C_{tr,with}) - (R_{w,without} + C_{tr,without})$$

3.8
basic element
the wall or ceiling (floor) to which the additional lining is fixed

4 Test arrangement

4.1 Test facilities

The measurements shall be carried out in laboratory test facilities for walls or floors with suppressed flanking transmission according to EN ISO 140-1.

4.2 Mounting of the specimens

The specimen — i.e. the additional lining — and the basic structure shall cover the whole test opening. The lining shall be mounted to the basic element as in practice. The lining shall be linked to the flanking parts of the laboratory as in practice, considering the following: There shall be no strong coupling between the basic element and the lining along the edges by the flanking elements of the laboratory. Either the flanking parts of the laboratory are heavy enough — for details see EN ISO 140-1:1997/prA1:2002 — or there shall be a structural break in the flanking elements, positioned between the basic element and the lining, or the lining shall not be rigidly fixed along its edges to the flanking elements but only flexibly sealed.

4.3 Basic elements

4.3.1 General

Corresponding to the application of the lining, the following constructions (4.3.2 and 4.3.3) shall be used. The wall with medium high coincidence frequency according to 4.3.4 shall be used in addition, when this case covers the field of application of the lining. Other basic elements may optionally be used for extra information, but the results are not usually comparable to measurement results determined by means of the obligatory basic elements. This shall be clearly stated with the results.

4.3.2 Basic wall with low coincidence frequency ("heavy basic wall")

Masonry, homogeneous concrete or concrete blocks with a surface mass m of (350 ± 50) kg/m². Material and thickness shall be chosen such that the coincidence frequency is located in the 125 Hz octave band. This may be calculated or measured. No cavities are allowed and no thickness resonances below 3 150 Hz. The density of the blocks shall be at least 1 600 kg/m³. If the wall is not airtight, it shall be plastered on the side facing the lining.

EXAMPLE Masonry of calcium silicate blocks. Density of the blocks: 1 700 kg/m³ $\leq \rho$ <1 800 kg/m³. Thickness of the blocks: 17,5 cm. 10 mm gypsum plaster on one side of the wall.

4.3.3 Basic floor with low coincidence frequency ("heavy basic floor")

A heavy homogeneous concrete floor shall be used as described in EN ISO 140-8:1997, 5.2.3 (Thickness: 120^{+40}_{-20} mm, preferably 140 mm).

4.3.4 Basic wall with medium coincidence frequency ("lightweight basic wall")

Wall of 10 cm cellular concrete, density ρ = (600 ± 50) kg/m³, with 10 mm gypsum plaster on the side facing the lining.

NOTE This wall is supposed to have a mass per unit area of about 70 kg/m² and a coincidence frequency within the 500 Hz octave band. Other material is allowed, as long as the same ranges of mass per unit area and coincidence frequencies are maintained.