INTERNATIONAL STANDARD

ISO 717-2

Second edition
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Acoustics — Rating of sound insulation in buildings and of buildings elements —

Part 2:
Impact sound insulation

Acoustique — Évaluation de l'isolement acoustique des immeubles et des éléments de construction —

Partie 2: Protection contre le bruit de choc

Reference number
ISO 717-2:1996(E)

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.

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.

International Standard ISO 717-2 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

This second edition of ISO 717-2 cancels and replaces the first edition (ISO 717-2:1982), which has been technically revised.

ISO 717 consists of the following parts, under the general title:

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

— *Part 1: Airborne sound insulation*

— *Part 2: Impact sound insulation*

Annexes A, B, C and D of this part of ISO 717 are for information only.

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Introduction

Methods of measurement of impact sound insulation in buildings and of building elements have been standardized in ISO 140-6, ISO 140-7 and ISO 140-8. These methods give values for the impact sound insulation which are frequency dependent. The purpose of this part of ISO 717 is to standardize a method whereby the frequency-dependent values of impact sound insulation can be converted into a single number characterizing the acoustical performance.

The method has been widely used since 1968. However, since there is some evidence that it could be improved, a spectrum adaptation term is added and it is recommended to gather experience with this.

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

Part 2:
Impact sound insulation

1 Scope

This part of ISO 717

a) defines single-number quantities for the impact sound insulation in buildings and of floors;

b) gives rules for determining these quantities from the results of measurements carried out in one-third-octave bands in accordance with ISO 140-6 and ISO 140-7, and in octave bands in accordance with that option in ISO 140-7 for field measurements only; and

c) defines single-number quantities for the impact sound reduction of floor coverings and floating floors from the results of measurements carried out in accordance with ISO 140-8.

The single-number quantities in accordance with this part of ISO 717 are intended for rating the impact sound insulation and for simplifying the formulation of acoustical requirements in buidling codes. The required numerical values of the single-number quantities are specified according to varying needs.

The rating of results from measurements carried out over an enlarged frequency range is dealt with in annex A.

A method for obtaining single-number quantities for bare massive floors according to their performance in combination with floor coverings is described in annex B.

An example of the calculation of a single-number quantity is given in annex C.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 717. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 717 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 140-6:—[1]), *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 6: Laboratory measurements of impact sound insulation of floors.*

ISO 140-7:—[2]), *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 7: Field measurements of impact sound insulation of floors.*

ISO 140-8:—[3]), *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 8: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a standard floor.*

1) To be published. (Revision of ISO 140-6:1978)
2) To be published. (Revision of ISO 140-7:1978)
3) To be published. (Revision of ISO 140-8:1978)

3 Definitions

For the purposes of this part of ISO 717, the following definitions apply.

3.1 single-number quantity for impact sound insulation rating derived from one-third-octave band measurements: Value, in decibels, of the relevant reference curve at 500 Hz after shifting it in accordance with the method specified in this part of ISO 717.

3.2 single-number quantity for impact sound insulation rating derived from octave band measurements: Value, in decibels, of the relevant reference curve at 500 Hz after shifting it in accordance with the method specified in this part of ISO 717, reduced by 5 dB.

NOTES

1 Terms and symbols for the single-number quantity used depend on the type of measurement. They are listed in table 1 for impact sound insulation properties of building elements and in table 2 for impact sound insulation between rooms in buildings.

2 In order to distinguish clearly between values with and without flanking transmission, primed symbols (e.g. L'_{n}) are used to denote values obtained with flanking transmission.

3.3 weighted reduction in impact sound pressure level: Difference between the weighted normalized impact sound pressure levels of a reference floor without and with a floor covering, obtained in accordance with the method specified in this part of ISO 717. This quantity is denoted by ΔL_{w} and is expressed in decibels.

3.4 spectrum adaptation term, C_{I}: Value, in decibels, to be added to the single-number quantity to take account of the unweighted impact sound level, thereby representing the characteristics of typical walking noise spectra.

3.5 equivalent weighted normalized impact sound pressure level of a bare massive floor: Sum of the weighted normalized impact sound pressure level of the bare floor under test with the reference floor covering and the weighted reduction in impact sound pressure level of the reference floor covering obtained in accordance with the method specified in this part of ISO 717. This quantity is denoted by $L_{\mathrm{n,eq,0,w}}$ and is expressed in decibels.

Table 1 — Single-number quantities of impact sound insulation properties of floors

Derived from one-third-octave band values: Single-number quantity	Term and symbol	Defined in	
Weighted normalized impact sound pressure level, $L_{\mathrm{n,w}}$	Normalized impact sound pressure level, L_{n}	ISO 140-6:—	equation (4)

Table 2 — Single-number quantities of impact sound insulation between rooms in buildings

Derived from one-third-octave band values or octave-band values: Single-number quantity	Term and symbol	Defined in	
Weighted normalized impact sound pressure level, $L'_{\mathrm{n,w}}$	Normalized impact sound pressure level, L'_{n}	ISO 140-7:—	equation (2)
Weighted standardized impact sound pressure level, $L'_{\mathrm{n}T\mathrm{,w}}$	Standardized impact sound pressure level, $L'_{\mathrm{n}T}$	ISO 140-7:—	equation (3)

4 Procedure for evaluating single-number quantities for impact sound insulation rating

4.1 General

The values obtained in accordance with ISO 140-6 and ISO 140-7 are compared with reference values (see 4.2) at the frequencies of measurement within the range 100 Hz to 3 150 Hz for measurements in one-third-octave bands or 125 Hz to 2 000 Hz for measurements in octave bands. The comparison shall be carried out in accordance with 4.3.

4.2 Reference values

The set of reference values used for comparison with measurement results shall be as given in table 3. The reference curves are shown in figures 1 and 2.

NOTE 3 The reference values for the octave bands 125 Hz to 1 000 Hz are equivalent to the energetic sum (rounded to integers) of these for the relevant one-third-octave band values. The reference value for the octave band 2 000 Hz has been reduced to take care of the one-third-octave band 3 150 Hz, which (for bare massive floors) may contribute considerably to the unfavourable deviations.

4.3 Method of comparison

4.3.1 Measurements in one-third-octave bands

To evaluate the results of a measurement of L_{n}, L'_{n} or $L'_{\mathrm{n}T}$ in one-third-octave bands (given to one decimal place), shift the reference curve in steps of 1 dB towards the measured curve until the sum of unfavourable deviations is as large as possible but not more than 32,0 dB.

An unfavourable deviation at a particular frequency occurs when the results of measurements exceed the reference value. Only the unfavourable deviations shall be taken into account.

The value, in decibels, of the reference curve at 500 Hz, after shifting it in accordance with this procedure, is $L_{\mathrm{n,w}}$, $L'_{\mathrm{n,w}}$ or $L'_{\mathrm{n}T\mathrm{,w}}$ respectively.

4.3.2 Measurements in octave bands

To evaluate the results of a field measurement of L'_{n} or $L'_{\mathrm{n}T}$ in octave bands (given to one decimal place), shift the reference curve in steps of 1 dB towards the measured curve until the sum of unfavourable deviations is as large as possible but not more than 10,0 dB.

The value, in decibels, of the reference curve at 500 Hz, after shifting it in accordance with this procedure and then reducing it by 5 dB is $L'_{\mathrm{n,w}}$ or $L'_{\mathrm{n}T\mathrm{,w}}$ respectively.

An unfavourable deviation at a particular frequency occurs when the results of measurements exceed the reference value. Take into account only the unfavourable deviations.

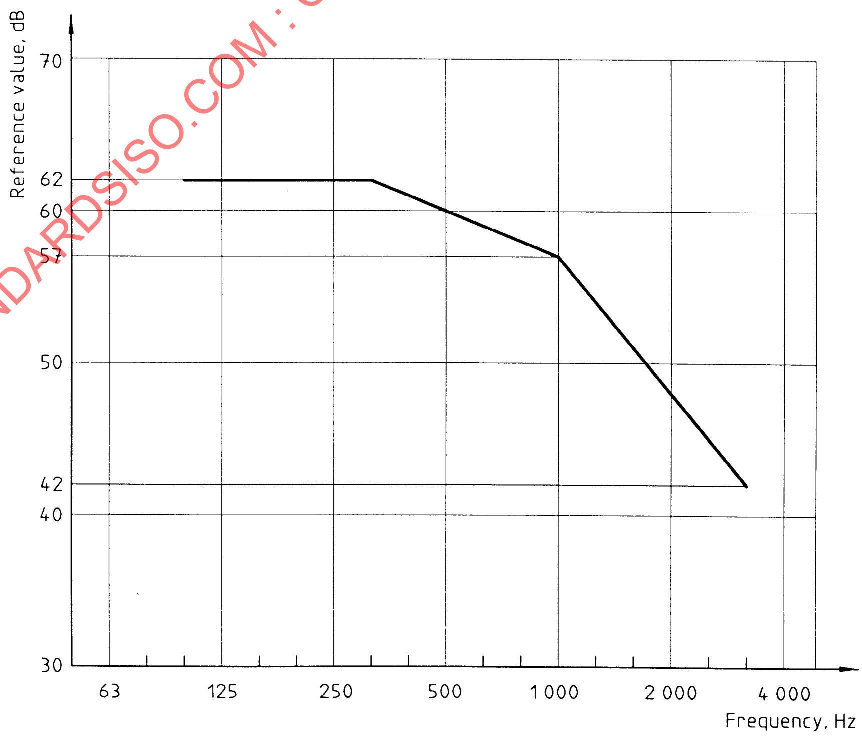

Figure 1 — Curve of reference values for impact sound, one-third-octave bands

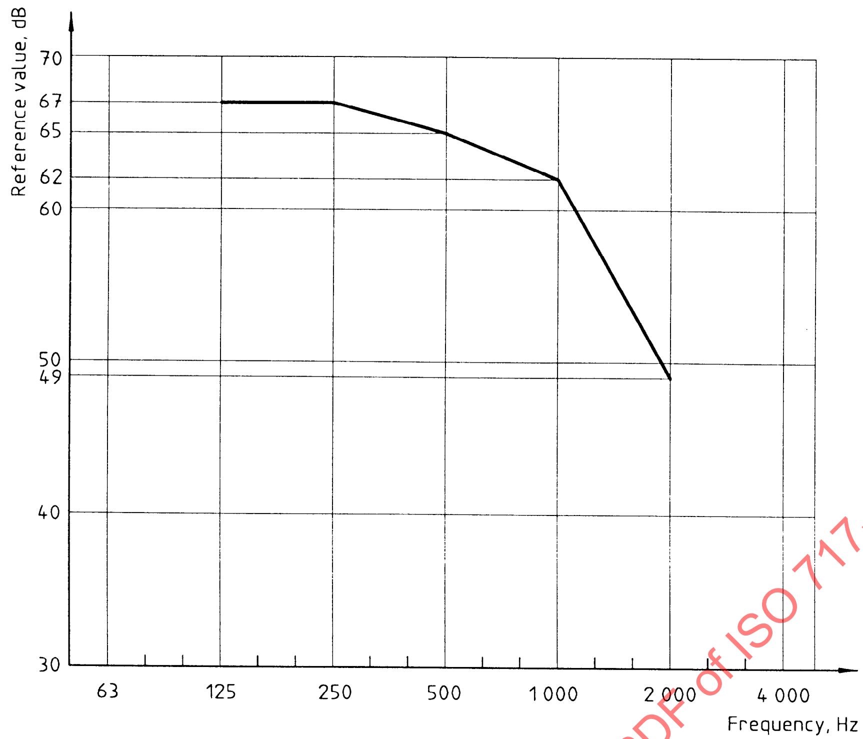

Figure 2 — Curve of reference values for impact sound, octave bands

Table 3 — Reference values for impact sound

Frequency Hz	**Reference values,** dB One-third-octave bands	Octave bands
100	62	
125	62	67
160	62	
200	62	
250	62	67
315	62	
400	61	
500	60	65
630	59	
800	58	
1 000	57	62
1 250	54	
1 600	51	
2 000	48	49
2 500	45	
3 150	42	

4.4 Statement of results

The appropriate single-number quantity shall be given with reference to this part of ISO 717. The results of measurements shall also be given in the form of a diagram as specified in ISO 140-6 and ISO 140-7.

For field measurements in accordance with ISO 140-7, it shall be stated whether the single-number quantity is calculated from measuring results in one-third-octave bands or octave bands. In general there may be differences between single numbers calculated from one-third-octave or octave band measurements of about ± 1 dB. Ratings based on one-third-octave band measurements are preferred.

5 Procedure for evaluating the weighted reduction in impact sound pressure level

5.1 General

The reduction of impact sound pressure level (improvement of impact sound insulation), ΔL, of floor coverings when tested on a homogeneous concrete slab floor as described in ISO 140-8 is independent of the normalized impact sound pressure level of the bare floor, $L_{n,0}$. However, the weighted normalized impact sound pressure levels of the floor with and without a floor covering depend to some extent on $L_{n,0}$. In order to obtain comparable values for ΔL_w between laboratories, it is therefore necessary to relate the measured values of ΔL to a reference floor.

5.2 Reference floor

The reference floor is defined by the values for the normalized impact sound pressure level $L_{n,r,0}$ given in table 4.

Table 4 — Normalized impact sound pressure level of the reference floor

Frequency Hz	$L_{n,r,0}$ dB
100	67
125	67,5
160	68
200	68,5
250	69
315	69,5
400	70
500	70,5
630	71
800	71,5
1 000	72
1 250	72
1 600	72
2 000	72
2 500	72
3 150	72

The weighted normalized impact sound pressure level of the reference floor, $L_{n,r,0,w}$, evaluated in accordance with 4.3.1, is 78 dB.

NOTE 4 The values given in table 4 represent a straight-line idealization of the normalized impact sound pressure level of a 120 mm homogeneous concrete floor slab, levelling off, as in the practical case, at frequencies above 1 000 Hz.

5.3 Calculation

Calculate the weighted reduction of impact sound pressure level ΔL_w according to the following equations:

$$L_{n,r} = L_{n,r,0} - \Delta L$$

$$\Delta L_w = L_{n,r,0,w} - L_{n,r,w}$$

$$= 78 \text{ dB} - L_{n,r,w}$$

where

$L_{n,r}$ is the calculated normalized impact sound pressure level of the reference floor with the floor covering under test;

$L_{n,r,0}$ is the defined normalized impact sound pressure level of the reference floor (see table 4);

ΔL is the reduction in impact sound pressure level measured in accordance with ISO 140-8;

$L_{n,r,w}$ is the calculated weighted normalized impact sound pressure level of the reference floor with the floor covering under test;

$L_{n,r,0,w}$ is obtained from $L_{n,r,0}$ in accordance with 4.3.1.

5.4 Statement of results

The single-number quantity ΔL_w shall be given with reference to this part of ISO 717. The results of measurements shall also be given in the form of a diagram as specified in ISO 140-8.

NOTE 5 The reduction in impact sound pressure level measured on a concrete floor slab as defined in ISO 140-8 and the single-number quantity ΔL_w may only be used in connection with similar types of massive floors (concrete, hollow concrete, hollow bricks and similar); it is not appropriate for use on other types of construction.

Annex A
(informative)

Additional weighting procedure

A.1 General

This annex introduces an additional rating method by describing an adaptation term based on the unweighted linear impact sound level.

The rating by $L_{n,w}$ has been shown to be quite adequate in characterizing impact noise like walking for wooden floors and concrete floors with effective coverings such as carpets or floating floors. However, it insufficiently takes into account level peaks at single (low) frequencies, for instance with timber joist floors, or the behaviour of bare concrete floors in this respect. There is clear evidence (see references [1] to [4]) that the unweighted impact level of the tapping machine is more representative of the A-weighted impact levels as caused by walking for all types of floor, while this rating is also more restrictive to single noise peaks (replacing thereby the 8-dB rule which was used in the first edition of ISO 717-2).

Therefore an adaptation term C_I is introduced to take this effect into account, given as a separate number which cannot be confused with the value for $L_{n,w}$. This term is so defined that for massive floors with effective coverings its value is about zero, while for timber joist floors with dominating low frequency peaks it will be slightly positive. For concrete floors without cover or with less effective covering, it will range from −15 dB to 0 dB.

If these effects are to be taken into account in requirements, these could be written as the sum of $L'_{n,w}$ and C_I.

A.2 Calculation of spectrum adaptation term

A.2.1 Spectrum adaptation term for impact sound level

The results of a measurement of L_n, L'_n or L'_{nT} in one-third-octave bands in the frequency range 100 Hz to 2 500 Hz or in octave bands in the frequency range 125 Hz to 2 000 Hz are added up on an energetic basis[4)] to $L_{n,sum}$, $L'_{n,sum}$ or $L'_{nT,sum}$. The adaptation term C_I is then calculated from one of the following equations:

$$C_I = L_{n,sum} - 15 - L_{n,w} \quad \text{dB}$$

$$C_I = L'_{n,sum} - 15 - L'_{n,w} \quad \text{dB}$$

$$C_I = L'_{nT,sum} - 15 - L'_{nT,w} \quad \text{dB}$$

The spectrum adaptation term is calculated to the nearest 0,1 dB and rounded to an integer[5)].

NOTE 6 Calculations of the spectrum adaptation term may additionally be carried out for an enlarged frequency range (including 50 Hz + 63 Hz + 80 Hz). The term is then to be denoted as $C_{I,50\text{-}2500}$ or $C_{I,63\text{-}2000}$.

An example of the calculation of the single-number quantity and the adaptation term is given in annex C.

4) The summation on an energetic basis is calculated for k frequency bands by

$$L_{sum} = 10 \lg \sum_{i=1}^{k} 10^{L_i/10} \text{ dB}$$

5) The value $+xy$,5 is rounded to xy + 1 and $-xy$,5 is rounded to $-xy$. For further details, see ISO 31-0[5].

A.2.2 Spectrum adaptation term for the impact sound reduction of floor coverings

To gather experience in the field of the (newly introduced) unweighted impact sound level in addition to the calculation of the weighted reduction in impact sound pressure level ΔL_w based on the reference curve (figure 1), a spectrum adaptation term for flat response for the impact sound reduction may be determined and stated. This spectrum adaptation term $C_{I\Delta}$ is calculated from

$$C_{I\Delta} = C_{I,r,0} - C_{I,r}$$

where

$C_{I,r}$ is the spectrum adaptation term for the reference floor with the floor covering under test;

$C_{I,r,0}$ is the spectrum adaptation term for the reference floor with $L_{n,r,0}$ in accordance with A.2.1 ($C_{I,r,0} = -11$ dB).

A single-number reduction based on the unweighted linear impact sound pressure level ΔL_{lin} may be calculated from

$$\Delta L_{lin} = L_{n,r,0,w} + C_{I,r,0} - (L_{n,r,w} + C_{I,r}) = \Delta L_w + C_{I,\Delta}$$

where

$L_{n,r,w}$ is the calculated normalized impact sound pressure level of the reference floor with the floor covering under test;

$L_{n,r,0,w}$ is obtained from $L_{n,r,0}$ in accordance with 4.3.1 ($L_{n,r,0,w} = 78$ dB).

Annex B
(informative)

Procedure for evaluating the equivalent weighted normalized impact sound pressure level of bare massive floors

B.1 General

For the rating of impact sound properties of floors in general, the weighted normalized impact sound pressure level $L_{n,w}$ is used. However, a bare concrete floor is seldom used without a floor covering.

Therefore in this annex a method to calculate an equivalent weighted normalized impact sound pressure level for bare concrete floors is given to describe the impact sound insulation of a bare floor with respect to the effect of a floor covering on this floor.

The equivalent weighted normalized impact sound pressure level of a bare massive floor, $L_{n,eq,0,w}$ (see 3.5), can be used to calculate the weighted normalized impact sound pressure level $L_{n,w}$, of this bare floor with a floor covering with known ΔL_w, as follows:

$$L_{n,w} = L_{n,eq,0,w} - \Delta L_w$$

NOTE 7 It can be shown that $L_{n,eq,0,w}$ may be substituted by $(L_{n,0,w} + C_{I,0} + 10)$ and that $L_{n,w}$ for a bare floor characterized by $L_{n,0,w}$ with a covering characterized by ΔL_w and ΔL_{lin} may be calculated from

$$L_{n,w} = L_{n,0,w} + C_{I,0} + 10 - \Delta L_w \quad \text{dB}$$

or

$$L_{n,w} + C_I = L_{n,0,w} + C_{I,0} - \Delta L_{lin} \quad \text{dB}$$

$$= L_{n,0,w} + C_I - (\Delta L_w + C_{I\Delta}) \quad \text{dB}$$

where $C_{I,0}$ is the spectrum adaptation term for the bare floor.

B.2 Reference floor covering

The reference floor covering is defined by the values for the reduction of impact sound pressure level (improvement of impact sound insulation), ΔL_r, given in table B.1.

Table B.1 — Reduction in impact sound pressure level of the reference floor covering

Frequency Hz	ΔL_r dB
100	0
125	0
160	0
200	2
250	6
315	10
400	14
500	18
630	22
800	26
1000	30
1250	30
1600	30
2000	30
2500	30
3150	30

The weighted reduction in impact sound pressure level of the reference floor covering, $\Delta L_{r,w}$, evaluated in accordance with clause 5, is 19 dB.

NOTE 8 The values given in table B.1 represent a straight-line idealization of the general shape of the reduction in impact sound pressure level by a floor covering, with a slope of 12 dB per octave.

B.3 Calculation

The equivalent weighted normalized impact sound pressure level of bare massive floors, $L_{n,eq,0,w}$, is calculated using the following equations:

$$L_{n,1} = L_{n,0} - \Delta L_r$$

$$L_{n,eq,0,w} = L_{n,1,w} + \Delta L_{r,w}$$

$$= L_{n,1,w} + 19\ \text{dB}$$

where

$L_{n,1}$ is the calculated normalized impact sound pressure level of the floor under test with the reference floor covering;

$L_{n,0}$ is the normalized impact sound pressure level of the bare floor under test, measured in accordance with ISO 140-6;

ΔL_r is the defined reduction in impact sound pressure level of the reference floor covering (see table B.1);

$L_{n,1,w}$ is the calculated weighted normalized impact sound pressure level of the floor under test with the reference floor covering;

$L_{n,1,w}$ is obtained from $L_{n,1}$ in accordance with 4.3.

Annex C
(informative)

Examples of the evaluation of a single-number quantity

Examples are given of the evaluation of a single-number quantity based on the result of

a) measurements in a laboratory with

— determination of the impact sound level of a bare massive floor, and of that floor with a floor covering (table C.1),

— determination of the reduction in impact sound pressure level of the floor covering (table C.2);

b) measurements *in situ* with determination of the impact sound level of the floor (table C.3).

Table C.1 — Measurements in a laboratory (in one-third-octave bands) on a bare massive floor and on that floor with a floor covering, then calculation of $L_{n,w}$ and C_I

f_I	Bare massive floor			With floor covering		
	L_n	Reference values shifted by +19 dB	Unfavourable deviation	L_n	Reference values shifted by +4 dB	Unfavourable deviation
Hz	dB	dB	dB	dB	dB	dB
100	62,1	81		59,1	66	
125	63,2	81		59,5	66	
160	63,5	81		61,6	66	
200	66,2	81		63,2	66	
250	68,5	81		65,3	66	
315	70,0	81		66,5	66	0,5
400	71,7	81		67,7	65	2,7
500	73,1	79		67,0	64	3,0
630	73,8	78		67,1	63	4,1
800	73,5	77		66,5	62	4,5
1 000	73,8	76		66,1	61	5,1
1 250	73,3	73	0,3	62,5	58	4,5
1 600	73,1	70	3,1	57,9	55	2,9
2 000	73,0	67	6,0	52,7	52	0,7
2 500	72,4	64	8,4	47,0	49	
3 150	71,2	61	10,2	48,0	46	2,0
	$L_{n,sum}$ = 83,5 dB C_I = 83,5 – 15 – 79 = – 10 dB		Sum 28,0 < 32,0 $L_{n,w}$ = 79 dB	$L_{n,sum}$ = 76,1 dB C_I = 76,1 – 15 – 64 = – 3 dB		Sum 30,0 < 32,0 $L_{n,w}$ = 64 dB

Table C.2 — Measurements in a laboratory (in one-third-octave bands) on a floor covering on a standard floor, then calculation of ΔL_w and ΔL_{lin}

f_1 Hz	L_n Bare floor $L_{n,0}$ dB	 With covering L_n dB	Reduction $\Delta L =$ $L_{n,0} - L_n$ dB	Reference floor $L_{n,r,0}$ dB	Reference floor $- \Delta L$ $(L_{n,r})$ dB	Reference value + 3 dB dB	Un-favourable deviation dB
100	65,2	62,2	3,0	67,0	64,0	65	
125	66,3	62,6	3,7	67,5	63,8	65	
160	68,0	66,1	1,9	68,0	66,1	65	1,1
200	68,5	65,5	3,0	68,5	65,5	65	0,5
250	68,0	64,8	3,2	69,0	65,8	65	0,8
315	69,0	65,5	3,5	69,5	66,0	65	1,0
400	69,3	65,3	4,0	70,0	66,0	64	2,0
500	70,2	64,1	6,1	70,5	64,4	63	1,4
630	70,7	64,0	6,7	71,0	64,3	62	2,3
800	71,2	64,2	7,0	71,0	64,5	61	3,5
1000	71,5	63,8	7,7	72,0	64,3	60	4,3
1250	72,1	61,3	10,8	72,0	61,2	57	4,2
1600	73,0	57,8	15,2	72,0	56,8	54	2,8
2000	74,0	53,7	20,3	72,0	51,7	51	0,7
2500	73,5	48,1	25,4	72,0	46,6	48	
3150	73,1	49,9	23,2	72,0	48,8	45	3,8
				$L_{n,sum} = 75,7$ dB $C_{I,r} = 75,7 - 15 - 63 = -2$ dB $\Delta L_{lin} = 78 - 10 - (63-2) = 7$ dB		Sum $28,4 < 32,0$ $L_{n,w,r} = 63$ dB $\Delta L_w = 78 - 63 = 15$ dB	

Table C.3 — Measurement *in situ* (in octave bands), then calculation of $L_{n,w}$ and C_I

f_1 Hz	L_n dB	Reference value shifted by − 6 dB dB	Unfavourable deviation dB
125	65,3	61	4,3
250	64,5	61	3,5
500	58,0	59	
1000	55,8	56	
2000	43,0	43	
	$L_{n,sum} = 68,6$ dB $C_I = 68,6 - 15 - 54 = 0$ dB		Sum $7,8 < 10,0$ dB $L_{n,w} = 54$ dB

Annex D
(informative)

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