INTERNATIONAL STANDARD

ISO 717-2

Third edition
2013-03-01

Acoustics — Rating of sound insulation in buildings and of building 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 717-2:2013(E)

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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.

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

This third edition cancels and replaces the second edition (ISO 717-2:1996), which has been technically revised. It also incorporates the Amendment ISO 717-2:1996/Amd. 1:2006.

The purpose of this revised version is to:

— allow weighting steps of 0,1 dB to be used for expression of uncertainty;

— update references.

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*

Introduction

Methods of measurement of impact sound insulation in buildings and of building elements have been standardized in ISO 10140-3 and ISO 140-7. 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 that experience be gathered with this.

References to standards which provide data for single-number evaluation are meant to be examples and not complete surveys.

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 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 10140-3 and ISO 140-7, and in octave bands in accordance with that option in ISO 140-7 for field measurements only;

c) defines single-number quantities for the impact sound reduction of floor coverings and floating floors calculated from the results of measurements carried out in accordance with ISO 10140-3;

d) specifies a procedure for evaluating the weighted reduction in impact sound pressure level by floor coverings on lightweight floors.

The single-number quantities in accordance with this part of ISO 717 are intended for rating impact sound insulation and for simplifying the formulation of acoustical requirements in building codes. An additional single-number evaluation in steps of 0,1 dB is indicated for the expression of uncertainty (except for spectrum adaptation terms).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 described in Annex A.

A method for obtaining single-number quantities for bare heavy 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 140-7:1998, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 7: Field measurements of impact sound insulation of floors*

ISO 10140-1, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 1: Application rules for specific products*

ISO 10140-3:2010, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 3: Measurement of impact sound insulation*

ISO 10140-5, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 5: Requirements for test facilities and equipment*

3 Terms and definitions

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

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

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

3.2
single-number quantity for impact sound insulation rating derived from octave band measurements
value 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

Note 1 to entry: Terms and symbols for the single-number quantity used depend on the type of measurement. Examples 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.

Note 2 to entry: 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.

Note 3 to entry: This quantity is expressed in decibels.

3.3
weighted reduction in impact sound pressure level
difference between the weighted normalized impact sound pressure levels derived with a bare heavy reference floor or with a lightweight reference floor without and with a floor covering, obtained in accordance with the method specified in this part of ISO 717

Note 1 to entry: The quantity derived with a bare heavy reference floor is denoted by ΔL_w and is expressed in decibels.

Note 2 to entry: The quantity derived with a bare heavy reference floor is denoted by $\Delta L_{t,w}$ and is expressed in decibels. According to the type of reference floor it may be denoted by $\Delta L_{t1,w}$, $\Delta L_{t2,w}$, $\Delta L_{t3,w}$.

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 heavy 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

Note 1 to entry: This quantity is denoted by $L_{n,eq,0,w}$ and is expressed in decibels.

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

Derived from one-third-octave band values		Defined in	
Single-number quantity	**Term and symbol**		
Weighted normalized impact sound pressure level, $L_{n,w}$	Normalized impact sound pressure level, L_n	ISO 10140-3:2010	Formula (1)

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

Derived from one-third-octave band values or octave-band values		Defined in	
Single-number quantity	**Term and symbol**		
Weighted normalized impact sound pressure level, $L'_{n,w}$	Normalized impact sound pressure level, L'_{n}	ISO 140-7:1998	Formula (2)
Weighted standardized impact sound pressure level, $L'_{nT,w}$	Standardized impact sound pressure level, L'_{nT}	ISO 140-7:1998	Formula (3)

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

4.1 General

The values obtained in accordance with ISO 10140-3 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 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 heavy 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'_{nT} in one-third-octave bands, the measurement data shall be given to one decimal place.[1)] Shift the reference curve in increments of 1 dB (0,1 dB for the purpose of expression of uncertainty) 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 $L_{n,w}$, $L'_{n,w}$ or $L'_{nT,w}$ respectively.

1) The different parts of ISO 140 state that the results shall be reported "to one decimal place". However, if the octave or one-third-octave values have been reported with more than one decimal digit, the values shall be reduced to one decimal place before use in the calculation of the single number rating. This is done by taking the value in tenths of a decibel closest to the reported values: XX,XYZ ZZ ... is rounded to XX,X if Y is less than 5 and to XX,X + 0,1 if Y is equal to or greater than 5. Software developers should ensure that this reduction applies to the true input values and not only to the displayed precision (as shown on the screen or printed on paper). Generally this can be implemented by the following sequence of instructions: multiply the (positive) number XX,XYZ ZZ ... by 10 and add 0,5, take the integer part and then divide the result by 10. For further details see ISO 80000-1.[1]

Table 3 — Reference values for impact sound

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

4.3.2 Measurements in octave bands

To evaluate the results of a measurement of L'_{n} or $L'_{\mathrm{n}T}$ in octave bands, the measurement data shall be given to one decimal place.1) Shift the reference curve in increments of 1 dB (0,1 dB for the purpose of expression of uncertainty) 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.

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 10140-3 and ISO 140-7.

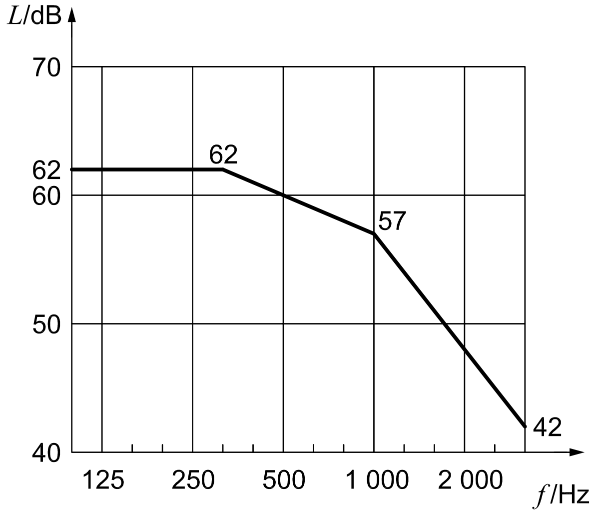
The uncertainty of the weighted single-number quantities may also be stated. In this case the numbers shall be given to one decimal place.

EXAMPLE

$$L_{\mathrm{n,w}} = 53{,}2\ \mathrm{dB} \pm 0{,}8\ \mathrm{dB}$$

Spectrum adaptation terms do not have uncertainty values of their own.

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 can be differences between single-number quantities calculated from one-third-octave or octave band measurements of about ±1 dB. Ratings based on one-third-octave band measurements are preferred.

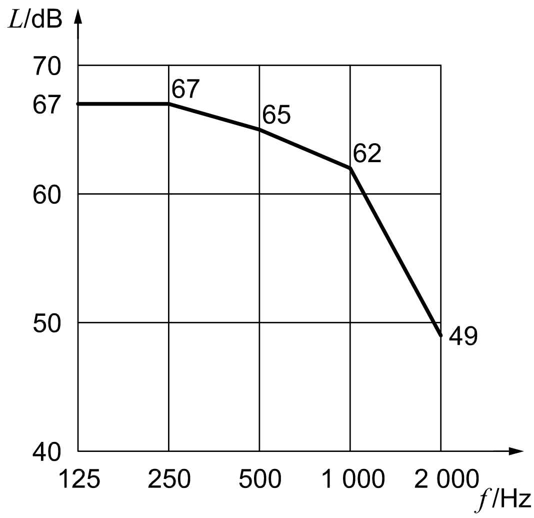


Key

L reference value

f frequency

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



Key

L reference value

f frequency

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

5 Procedure for evaluating the weighted reduction in impact sound pressure level by floor coverings on bare heavy floors

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 10140-1 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
100 125 160	67 67,5 68
200 250 315	68,5 69 69,5
400 500 630	70 70,5 71
800 1 000 1 250	71,5 72 72
1 600 2 000 2 500	72 72 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 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 Formulae (1) and (2):

$$L_{n,r} = L_{n,r,0} - \Delta L \tag{1}$$

$$\Delta L_w = L_{n,r,0,w} - L_{n,r,w} = 78\ \text{dB} - L_{n,r,w} \tag{2}$$

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 10140-1;

$L_{n,r,w}$ 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 10140-1.

The uncertainty of ΔL_w may also be stated. In this case the numbers shall be given to one decimal place.

EXAMPLE

$$\Delta L_w = 18{,}9\ \text{dB} \pm 0{,}8\ \text{dB}$$

Spectrum adaptation terms do not have uncertainty values of their own.

The reduction in impact sound pressure level measured on a concrete floor slab as defined in ISO 10140-1 and the single-number quantity ΔL_w may only be used in connection with similar types of massive floors (concrete, hollow concrete, hollow bricks, etc.); it is not appropriate for use on other types of construction.

6 Procedure for evaluating the weighted reduction in impact sound pressure level by floor coverings on lightweight floors

6.1 General

The reduction of impact sound pressure level (improvement of impact sound insulation), $\Delta L_{t,1}$, $\Delta L_{t,2}$, $\Delta L_{t,3}$, of floor coverings when tested on one of the three lightweight reference floors as described in ISO 10140-5 is independent of the normalized impact sound pressure level of the bare reference floor $L_{n,t1,0}$, $L_{n,t2,0}$ and $L_{n,t3,0}$, respectively.

However, the weighted, normalized impact sound pressure levels of a lightweight floor with and without a floor covering depend on the $L_{n,t,0}$ value for the bare floor on which the floor covering is used. In order to obtain values for $\Delta L_{t,,w}$, which are comparable between laboratories and especially which can be used to calculate the normalized impact sound pressure level of lightweight floors with the floor covering, it is necessary to relate the measured values of $\Delta L_{t,1}$, $\Delta L_{t,2}$ and $\Delta L_{t,3}$ to the respective reference curves for the lightweight floors in ISO 10140-5.

6.2 Reference curves for the reference lightweight floors used to calculate $\Delta L_{t,w}$

In ISO 10140-5, there are three different reference lightweight floors and, therefore, it is necessary to define different types of reference curves for the calculation of $\Delta L_{t,w}$. The reference curves are defined by the relevant values for $L_{n,t,r,0}$. Table 5 contains the reference values for $L_{n,t,r,0}$ along with the weighted, normalized impact sound pressure levels for the different reference floors.

Table 5 — Normalized impact sound pressure level for the lightweight reference floors

Frequency	$L_{n,t,r,0}$ **for floors of type No 1 and No 2 in** ISO 10140-5	$L_{n,t,r,0}$ **for floors of type No. 3 in** ISO 10140-5
Hz	dB	dB
100	78	69
125	78	72
160	78	75
200	78	78
250	78	78
315	78	78
400	76	78
500	74	78
630	72	78
800	69	76
1 000	66	74
1 250	63	72
1 600	60	69
2 000	57	66
2 500	54	63
3 150	51	60
Weighted normalized impact sound pressure level	72	75

Values of $\Delta L_{t,w}$ calculated with the reference floor for type No. 1 or 2 shall be designated as $\Delta L_{t,1,w}$ or $\Delta L_{t,2,w}$ respectively; values of $\Delta L_{t,w}$ calculated with the reference floor for type No. 3 shall be designated as $\Delta L_{t,3,w}$.

6.3 Calculation

The calculation shall be carried out as specified in 5.3, substituting Table 5 for Table 4 and substituting nothing else.

6.4 Statement of results

The single number quantity $\Delta L_{t,1,w}$, $\Delta L_{t,2,w}$ or $\Delta L_{t,3,w}$ shall be given with reference to Clause 6. The results of measurements shall be given in the form of a diagram as specified in ISO 10140-1.

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 [2]–[5]) 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 ISO 717-2:1982.

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 shall be given to one decimal place, then added up on an energetic basis $L_{n,sum}$, $L'_{n,sum}$ or $L'_{nT,sum}$ and rounded to an integer.2)

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

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

The resulting spectrum adaptation term C_I is then calculated as an integer from one of Formulae (A.1) to (A.3):

$$C_I = \left(L_{n,sum} - 15 - L_{n,w} \right) \text{dB} \tag{A.1}$$

$$C_I = \left(L'_{n,sum} - 15 - L'_{n,w} \right) \text{dB} \tag{A.2}$$

2) XX,YZZ Z … is rounded to XX if Y is less than 5 and to XX + 1 if Y is greater than or equal to 5. For further details see ISO 80000-1.[1] Software implementers should be aware that calculation of the spectrum adaptation terms involves floating-point calculations that are never exact and may incur rounding errors. In some rare cases, this may lead to a difference of +1 dB or −1 dB in the final result. In order to avoid rounding errors, it is strongly recommended that the highest possible machine accuracy available be used for floating-point representation and mathematical operations.

$$C_{\mathrm{I}} = \left(L'_{\mathrm{n}T,\mathrm{sum}} - 15 - L'_{\mathrm{n}T,\mathrm{w}} \right) \mathrm{dB} \tag{A.3}$$

NOTE Calculations of the spectrum adaptation term can additionally be carried out for an enlarged frequency range (including 50 Hz + 63 Hz + 80 Hz). The term is then denoted as $C_{\mathrm{I},50\text{–}2\,500}$ or $C_{\mathrm{I},63\text{–}2\,000}$.

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

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

To gather experience in the field of the 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 $C_{\mathrm{I}\Delta}$ is calculated from

$$C_{\mathrm{I}\Delta} = C_{\mathrm{I,r,0}} - C_{\mathrm{I,r}} \tag{A.4}$$

where

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

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

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

$$\Delta L_{\mathrm{lin}} = L_{\mathrm{n,r,0,w}} + C_{\mathrm{I,r,0}} - (L_{\mathrm{n,r,w}} + C_{\mathrm{I,r}}) = \Delta L_{\mathrm{w}} + C_{\mathrm{I,\Delta}} \tag{A.5}$$

where

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

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

A.2.3 Spectrum adaptation term for the impact sound reduction of floor coverings on lightweight floors

To gather experience with the unweighted impact sound level for lightweight floors, a spectrum adaptation term for flat response for the impact sound reduction may also be calculated for the floor coverings on lightweight floors. The spectrum adaptation term, $C_{\mathrm{I}\Delta,\mathrm{t}}$, is calculated from Formula (A.6):

$$C_{\mathrm{I}\Delta,\mathrm{t}} = C_{\mathrm{I,t,r,0}} - C_{\mathrm{I,t,r}} \tag{A.6}$$

where

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

$C_{\mathrm{I,t,r,0}}$ is the spectrum adaptation term for the reference floor with $L_{\mathrm{n,t,r,0}}$ — it takes the value 0 dB for the reference curve for floors of type Nos. 1 and 2 and −3 dB for the reference curve for floors of type No. 3.

Values of $C_{\mathrm{I}\Delta,\mathrm{t}}$ calculated with the reference floor for type Nos. 1 or 2 shall be designated as $C_{\mathrm{I}\Delta,\mathrm{t1}}$ or $C_{\mathrm{I}\Delta,\mathrm{t2}}$.

Values of $C_{\mathrm{I}\Delta,\mathrm{t}}$ calculated with the reference floor for type No. 3 shall be designated as $C_{\mathrm{I}\Delta,\mathrm{t3}}$.

Annex B
(informative)

Procedure for evaluating the equivalent weighted normalized impact sound pressure level of bare heavy 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 heavy 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:

$$L_{n,w} = L_{n,eq,0,w} - \Delta L_w \quad \text{(B.1)}$$

NOTE It is possible to show that $L_{n,eq,0,w}$ can be substituted by ($L_{n,0,w} + C_{I,0} + 11$) 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} is given by

$$L_{n,w} = \left(L_{n,0,w} + C_{I,0} + 11 - \Delta L_w\right) \text{ dB} \quad \text{(B.2)}$$

or

$$L_{n,w} + C_I = \left(L_{n,0,w} + C_{I,0} - \Delta L_{lin}\right) \text{ dB} = \left[L_{n,0,w} + C_{I,0} - \left(\Delta L_w + C_{I\Delta}\right)\right] \text{ dB} \quad \text{(B.3)}$$

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.

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 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.

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
1 000	30
1 250	30
1 600	30
2 000	30
2 500	30
3 150	30

B.3 Calculation

The equivalent weighted normalized impact sound pressure level of bare massive floors, $L_{n,eq,0,w}$, is calculated using Formulae (B.4) and (B.5):

$$L_{n,1} = L_{n,0} - \Delta L_r \tag{B.4}$$

$$L_{n,eq,0,w} = L_{n,1,w} + \Delta L_{r,w} = L_{n,1,w} + 19\,\text{dB} \tag{B.5}$$

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 10140-3;

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 and 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 heavy 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).

NOTE In these examples, the addition has been performed including 3 150 Hz, which is not in accordance with the text: maximum is 2 500 Hz.

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

	Bare massive floor			With floor covering		
f_I	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
	$L_{n,sum}$ = 83,261 3... = 83 dB C_I = 83 − 15 − 79... = −11 dB		Sum 28,0 < 32,0 $L_{n,w}$ = 79 dB	$L_{n,sum}$ = 76,052 5... = 76 dB C_I = 76 − 15 − 64 = −3 dB		Sum 30,0 < 32,0 $L_{n,w}$ = 64 dB

Table C.2 — Example: 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}

	L_n						
f_I	**Bare floor** $L_{n,0}$	**With covering** L_n	**Reduction** $\Delta L = L_{n,0} - L_n$	**Reference floor** $L_{n,r,0}$	**Reduction** $-\Delta L(L_{n,r})$	**Reference value** + 3 dB	**Unfavourable deviation**
Hz	dB	dB	dB	dB	dB	dB	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
1 000	71,5	63,8	7,7	72,0	64,3	60	4,3
1 250	72,1	61,3	10,8	72,0	61,2	57	4,2
1 600	73,0	57,8	15,2	72,0	56,8	54	2,8
2 000	74,0	53,7	20,3	72,0	51,7	51	0,7
2 500	73,5	48,1	25,4	72,0	46,6	48	—
3 150	73,1	49,9	23,2	72,0	48,8	45	3,8
			$L_{n,sum}$ = 75,710 4… = 76 dB C_I = 76 − 15 − 63 = −2 dB ΔL_{lin} = 78 − 11 − (63 − 2) = 6 dB			Sum 28,4 < 32,0 $L_{n,w,r}$ = 63 dB ΔL_w = 78 − 63 = 15 dB	

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

f_I	L_n	Reference value shifted by −6 dB	Unfavourable deviation
Hz	dB	dB	dB
125	65,3	61	4,3
250	64,5	61	3,5
500	58,0	59	—
1 000	55,8	56	—
2 000	43,0	43	—
	$L_{n,sum}$ = 68,596 14... = 69 dB C_I = 69 − 15 − 54 = 0 dB		Sum 7,8 < 10,0 dB $L_{n,w}$ = 54 dB

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ICS 91.120.20
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