INTERNATIONAL STANDARD

ISO 717-1

Second edition
1996-12-15

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

Part 1:
Airborne sound insulation

Acoustique — Évaluation de l'isolement acoustique des immeubles et des éléments de construction —
Partie 1: Isolement aux bruits aériens

INTERNATIONAL ISO

Reference number
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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.

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 717-1 was prepared by Technical Commitee ISO/TC 43, *Acoustics*, Subcommittee SC 2, *Building acoustics*.

This second edition of ISO 717-1 cancels and replaces ISO 717-1:1982 and ISO 717-3:1982, which have 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 and C of this part of ISO 717 are for information only.

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Introduction

Methods of measurement of airborne sound insulation of building elements and in buildings have been standardized in ISO 140-3, ISO 140-4, ISO 140-5, ISO 140-9 and ISO 140-10. The purpose of this part of ISO 717 is to standardize a method whereby the frequency-dependent values of airborne sound insulation can be converted into a single number characterizing the acoustical performance.

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

Part 1:
Airborne sound insulation

1 Scope

This part of ISO 717

a) defines single-number quantities for airborne sound insulation in buildings and of building elements such as walls, floors, doors and windows;

b) takes into consideration the different sound level spectra of various noise sources such as noise sources inside a building and traffic outside a building; and

c) gives rules for determining these quantities from the results of measurements carried out in one-third-octave or octave bands in accordance with ISO 140-3, ISO 140-4, ISO 140-5, ISO 140-9 and ISO 140-10.

The single-number quantities in accordance with this part of ISO 717 are intended for rating the airborne sound insulation and for simplifying the formulation of acoustical requirements in building codes. The required numerical values of the single-number quantities are specified according to varying needs. The single-number quantities are based on results of measurements in one-third-octave bands or octave bands.

For laboratory measurements made in accordance with ISO 140-3, ISO 140-9 and ISO 140-10, single-number quantities should be calculated using one-third-octave bands only.

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

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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 140-4:—[1], *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 4: Field measurements of airborne sound insulation between rooms.*

ISO 140-5:—[2], *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 5: Field measurements of airborne sound insulation of façade elements and façades.*

ISO 140-9:1985, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 9: Laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it.*

1) To be published. (Revision of ISO 140-4:1978)
2) To be published. (Revision of ISO 140-5:1978)

ISO 140-10:1991, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 10: Laboratory measurement of airborne sound insulation of small building elements.*

3 Definitions

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

3.1 single-number quantity for airborne sound insulation rating: Value, in decibels, of the reference curve at 500 Hz after shifting it in accordance with the method specified in this part of ISO 717.

NOTE 1 Terms and symbols for the single-number quantity used depend on the type of measurement. They are listed in table 1 for airborne sound insulation properties of building elements and in table 2 for airborne sound insulation in buildings. In general, new single-number quantities are derived in a similar way.

3.2 spectrum adaptation term: Value, in decibels, to be added to the single-number rating (e.g. R_w) to take account of the characteristics of particular sound spectra.

NOTES

2 Two sound spectra are defined (in one-third-octave bands and in octave bands) in this part of ISO 717.

3 Annex A gives information on the purpose of introducing these two spectrum adaptation terms.

Table 1 — Single-number quantities of airborne sound insulation properties of building elements

Derived from one-third-octave band values		Defined in	
Single-number quantity	Term and symbol		
Weighted sound reduction index, R_w	Sound reduction index, R	ISO 140-3:1995	equation (4)
Weighted suspended-ceiling normalized level difference, $D_{n,c,w}$	Suspended-ceiling normalized level difference, $D_{n,c}$	ISO 140-9:1985	equation (3)
Weighted element-normalized level difference, $D_{n,e,w}$	Element-normalized level difference, $D_{n,e}$	ISO 140-10:1991	equation (1)

Table 2 — Single-number quantities of airborne sound insulation in buildings

Derived from one-third-octave or octave-band values		Defined in	
Single-number quantity	Term and symbol		
Weighted apparent sound reduction index, R'_w	Apparent sound reduction index, R'	ISO 140-4:—	equation (5)
Weighted apparent sound reduction index, $R'_{45°,w}$	Apparent sound reduction index, $R'_{45°}$	ISO 140-5:—	equation (3)
Weighted apparent sound reduction index, $R'_{tr,s,w}$	Apparent sound reduction index, $R'_{tr,s}$	ISO 140-5:—	equation (4)
Weighted normalized level difference, $D_{n,w}$	Normalized level difference, D_n	ISO 140-4:—	equation (3)
Weighted standardized level difference, $D_{nT,w}$	Standardized level difference, D_{nT}	ISO 140-4:—	equation (4)
Weighted standardized level difference, $D_{ls,2m,nT,w}$ or $D_{tr,2m,nT,w}$	Standardized level difference, $D_{ls,2m,nT}$ or $D_{tr,2m,nT}$	ISO 140-5:—	equation (7)

4 Procedure for evaluating single-number quantities

4.1 General

The values obtained in accordance with ISO 140-3, ISO 140-4, ISO 140-5, ISO 140-9 and ISO 140-10 are compared with reference values (see 4.2) at the frequencies of measurement within the range 100 Hz to 3 150 Hz for one-third-octave bands and 125 Hz to 2 000 Hz for octave bands.

The comparison shall be carried out as specified in 4.4

Furthermore, two spectrum adaptation terms shall be calculated (see 4.5) based on two typical spectra within the frequency range as quoted above. These two terms may optionally be supplemented by additional spectrum adaptation terms covering (if need be and if measured data are available) a wider frequency range between 50 Hz and 5 000 Hz.

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.

4.3 Sound spectra

The set of sound spectra in one-third-octave bands and octave bands to calculate the spectrum adaptation terms shall be as given in table 4 and shown in figures 3 and 4. The spectra are A-weighted and the overall spectrum level is normalized to 0 dB.

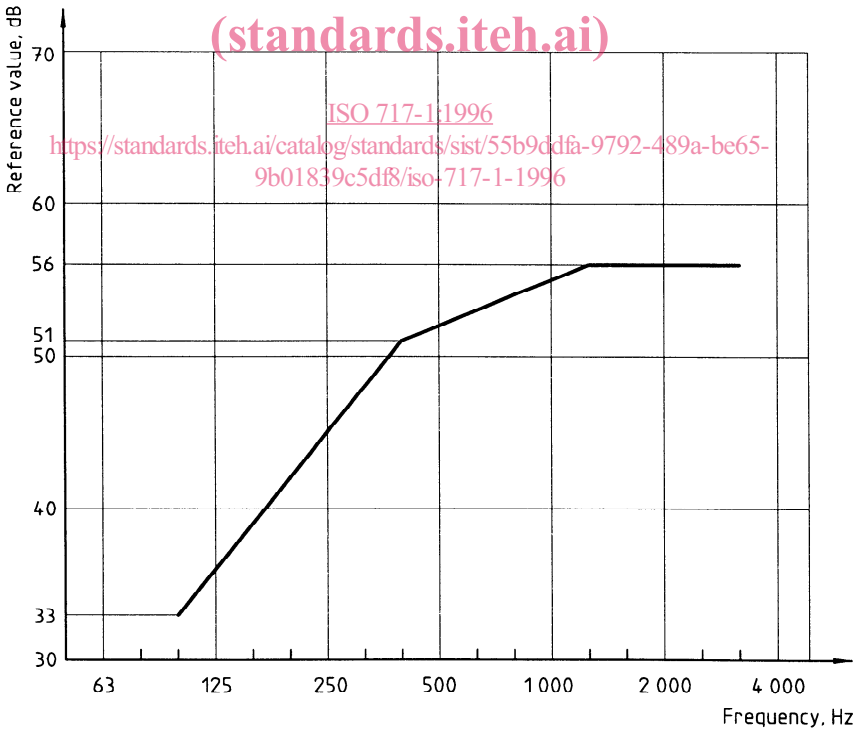


Figure 1 — Curve of reference values for airborne sound, one-third-octave bands

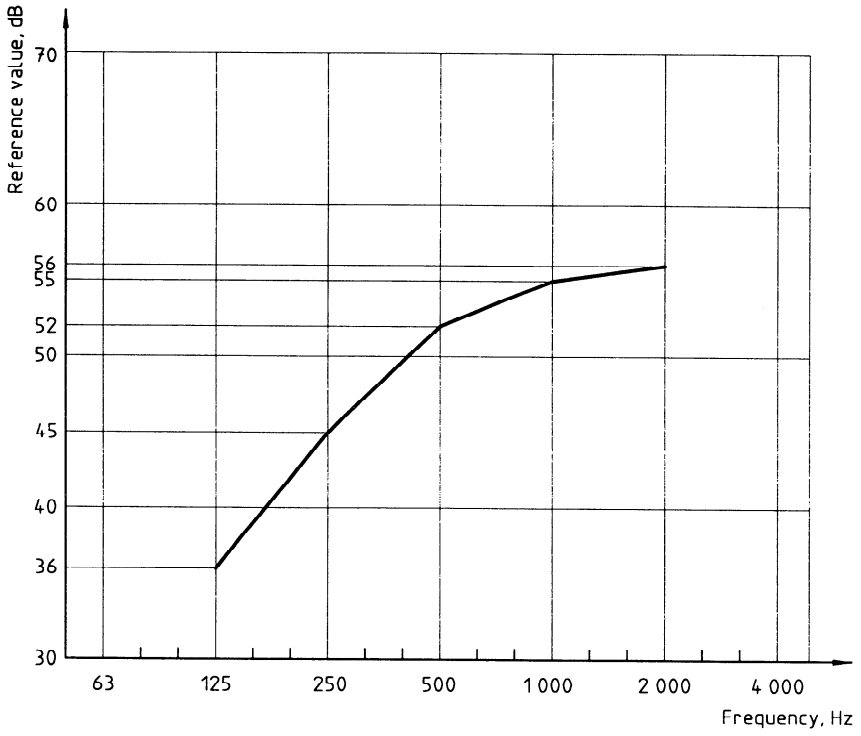
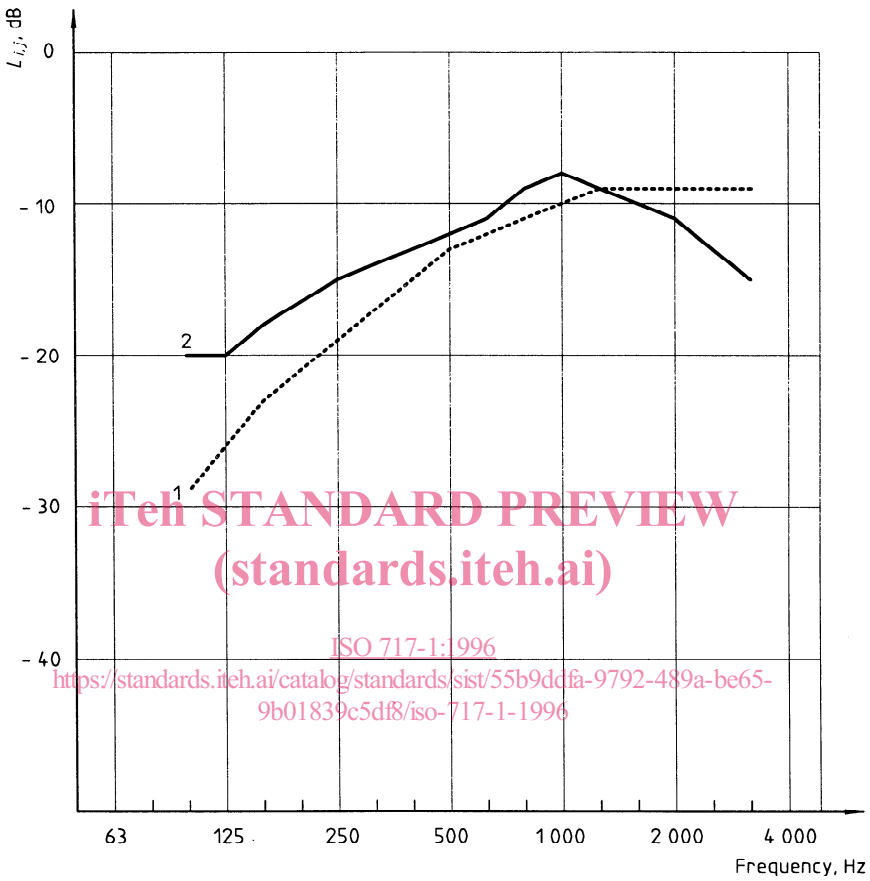


Figure 2 — Curve of reference values for airborne sound, octave bands

Table 3 — Reference values for airborne sound

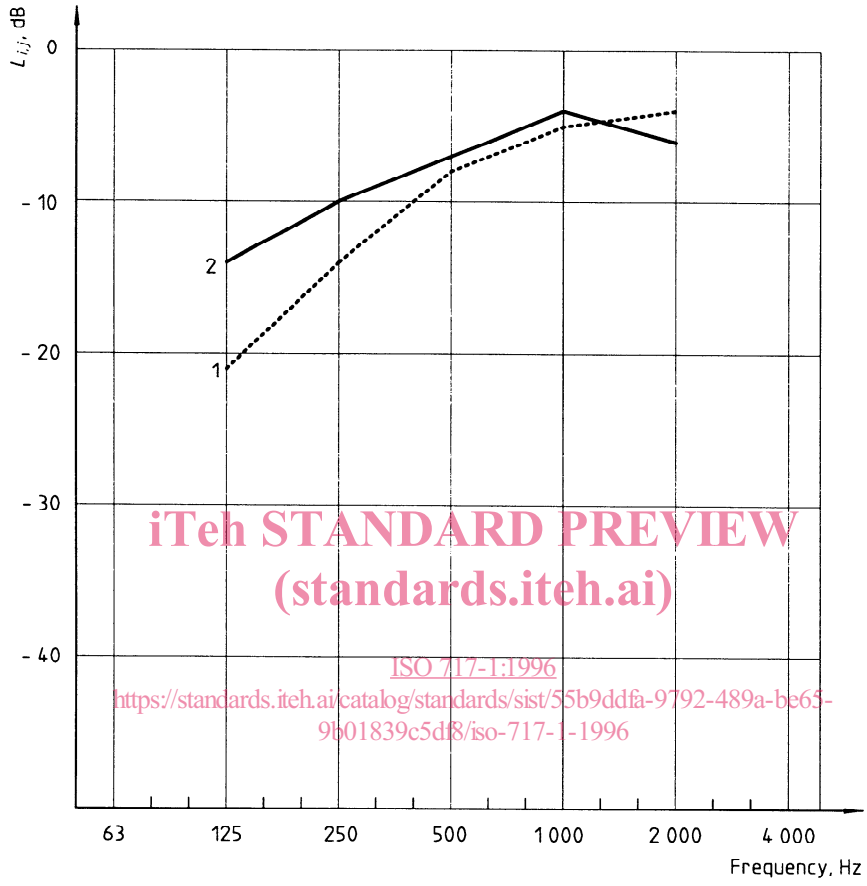
Frequency	Reference values, dB	
Hz	One-third-octave bands	Octave bands
100	33	
125	36	36
160	39	
200	42	
250	45	45
315	48	
400	51	
500	52	52
630	53	
800	54	
1 000	55	55
1 250	56	
1 600	56	
2 000	56	56
2 500	56	
3 150	56	



Key

---------- Spectrum No. 1 to calculate C
——— Spectrum No. 2 to calculate C_{tr}

Figure 3 — Sound level spectra to calculate the spectrum adaptation terms for one-third-octave band measurements



Key

--------- Spectrum No. 1 to calculate C
——— Spectrum No. 2 to calculate C_{tr}

Figure 4 — Sound level spectra to calculate the spectrum adaptation terms for octave-band measurements

Table 4 — Sound level spectra to calculate the adaptation terms

Frequency Hz	Sound levels, L_{ij}, dB			
	Spectrum No. 1 to calculate C		Spectrum No. 2 to calculate C_{tr}	
	One-third octave	Octave	One-third octave	Octave
100	– 29		– 20	
125	– 26	– 21	– 20	– 14
160	– 23		– 18	
200	– 21		– 16	
250	– 19	– 14	– 15	– 10
315	– 17		– 14	
400	– 15		– 13	
500	– 13	– 8	– 12	– 7
630	– 12		– 11	
800	– 11		– 9	
1 000	– 10	– 5	– 8	– 4
1 250	– 9		– 9	
1 600	– 9		– 10	
2 000	– 9	– 4	– 11	– 6
2 500	– 9		– 13	
3 150	– 9		– 15	

NOTE — All levels are A-weighted and the overall spectrum level is normalized to 0 dB.

4.4 Method of comparison

To evaluate the results of a measurement made in accordance with ISO 140-3, ISO 140-4, ISO 140-5, ISO 140-9 and ISO 140-10 in one-third-octave bands (or octave bands), given to 0,1 dB, shift the relevant 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 (measurement in 16 one-third-octave bands) or 10,0 dB (measurement in 5 octave bands).

An unfavourable deviation at a particular frequency occurs when the result of measurements is less than 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 R_w, R'_w, $D_{n,w}$ or $D_{nT,w}$, etc. (see tables 1 and 2).

Only use reference values in octave bands for comparison with results of measurements in octave bands in the field.

4.5 Calculation of spectrum adaptation terms

The spectrum adaptation terms, C_j, in decibels, shall be calculated with the sound spectra given in 4.3 from the following equation:

$$C_j = X_{Aj} - X_w$$

where

j is the index for the sound spectra Nos. 1 and 2;

X_w is the single-number quantity calculated according to 4.4 from R, R', D_n or D_{nT} values;

X_{Aj} is calculated from

$$X_{Aji} = -10 \lg \sum 10^{(L_{ij} - X_i)/10} \text{ dB}$$

where

i is the index for the one-third-octave bands 100 Hz to 3 150 Hz or the octave bands 125 Hz to 2 000 Hz;

L_{ij} are the levels as given in 4.3 at the frequency i for the spectrum j;

X_i is the sound reduction index R_i, or apparent sound reduction index R'_i, or normalized sound level difference $D_{n,i}$, or standardized sound level difference $D_{nT,i}$, at the measuring frequency i given to the nearest 0,1 dB.