BS EN 1793-1:2017

BSI Standards Publication

Road traffic noise reducing devices — Test method for determining the acoustic performance

Part 1: Intrinsic characteristics of sound absorption under diffuse sound field conditions

bsi.

National foreword

This British Standard is the UK implementation of EN 1793-1:2017. It supersedes BS EN 1793-1:2012 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/509/6, Fences for the attenuation of noise.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 1: Intrinsic characteristics of sound absorption under diffuse sound field conditions

Dispositifs de réduction du bruit du trafic routier - Méthode d'essai pour la détermination de la performance acoustique - Partie 1 : Caractéristique intrinsèques de l'absorption acoustique dans des conditions de champ acoustique diffus

Lärmschutzvorrichtungen an Straßen - Prüfverfahren zur Bestimmung der akustischen Eigenschaften - Teil 1: Produktspezifische Merkmale der Schallabsorption in diffusen Schallfeldern

This European Standard was approved by CEN on 6 February 2017.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 1793-1:2017) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2017, and conflicting national standards shall be withdrawn at the latest by September 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1793-1:2012.

With respect to the superseded document, the following changes have been made:

— the description of the test arrangement has been improved;

— the method for determining sound absorption coefficients in each one-third octave band, as described in EN ISO 354, has been modified: the Sabine absorption coefficient α_{Si} has been replaced by a new absorption coefficient $\alpha_{NRD,i}$ that is specific to noise reducing devices and which takes account of the volume of the test sample (the new coefficient $\alpha_{NRD,i}$ might be derived from α_{Si});

— the contents of the test report have been better defined;

— the declaration of the measurement uncertainty and the related confidence level is now mandatory. The reported uncertainties have an impact on the determination of informative categories of single number rating performance; depending on the performance of the product this could potentially result in products being 'downgraded' to a lower category. As a result, the informative annex addressing categories of single number rating has been removed. The performance of the noise reducing device is, from now on, only to be reported in terms of the numeric values of the single number rating;

— a detailed example is presented (Annex C).

EN 1793-1 is part of a series and should be read in conjunction with the following:

— EN 1793-2, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 2: Intrinsic characteristics of airborne sound insulation under diffuse sound field conditions*;

— EN 1793-3, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 3: Normalized traffic noise spectrum*;

— EN 1793-4, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 4: Intrinsic characteristics — In situ values of sound diffraction*;

— EN 1793-5, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 5: Intrinsic characteristics — In situ values of sound reflection under direct sound field conditions;*

— EN 1793-6, *Road traffic noise reducing devices — Test method for determining the acoustic performance — Part 6: Intrinsic characteristics — In situ values of airborne sound insulation under direct sound field conditions*.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Where a sound reflecting surface is installed along a road, it may be effective to use sound absorbing devices on its traffic side to reduce additional noise nuisance caused by reflected sound. This treatment may be needed in the presence of the following:

— noise barriers, rocks or retaining walls that can reflect sound waves toward unprotected areas;

— vertical cuttings or reflective surfaces that face each other;

— tunnels and their approaches;

— traffic passing close to a barrier where reflections between the vehicles and the barrier may reduce effectiveness.

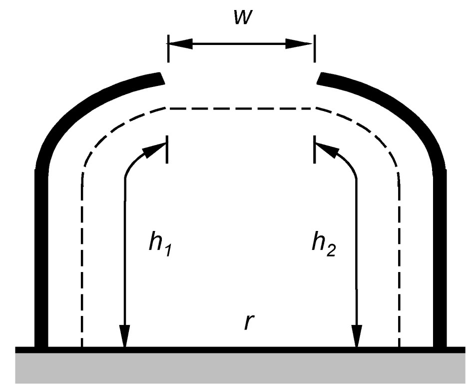
This European Standard specifies a test method for qualifying the sound absorption performance of noise reducing devices designed for roads (a measure of intrinsic performance). It is not concerned with determining insertion loss (extrinsic performance) which depends on additional factors which are not related to the product itself, e.g. the dimensions of the barrier and quality of installation work and site factors such as ground impedance, site geometry etc. The test is designed to allow the intrinsic sound absorption performance of the device to be measured under diffuse sound field conditions; the resulting rating should aid the selection of devices for particular roadside applications.

The measurement results of this method for sound absorption are not directly comparable with the results of the in situ method (EN 1793-5), mainly because the present method uses a diffuse sound field, while the in situ method assumes a directional sound field. The test method described in the present document should not be used to determine the intrinsic characteristics of sound absorption for noise reducing devices to be installed on roads under non-reverberant conditions.

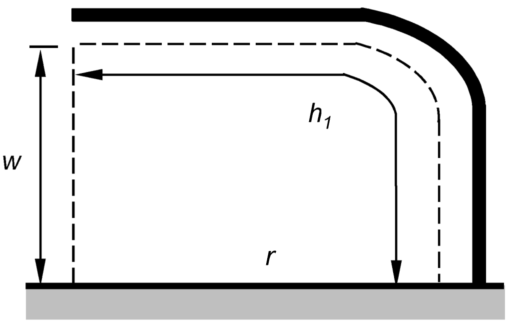
Research studies suggest that some correlation exists between laboratory data, measured according to EN 1793-5 and laboratory data, measured according to the method described in this European Standard [1], [2], [3], [4].

For the purpose of this European Standard, reverberant conditions are defined based on the envelope, *e,* across the road formed by the device under test, trench sides or buildings (the envelope does not include the road surface) as shown by the dashed lines in Figure 1. Conditions are defined as being reverberant when the percentage of open space in the envelope, w, is less than or equal to 25 %, i.e. reverberant conditions occur when $w/e \leq 0{,}25$, where $e = (w + h_1 + h_2)$ or $e = (w + h_1)$ as per Figure 1.

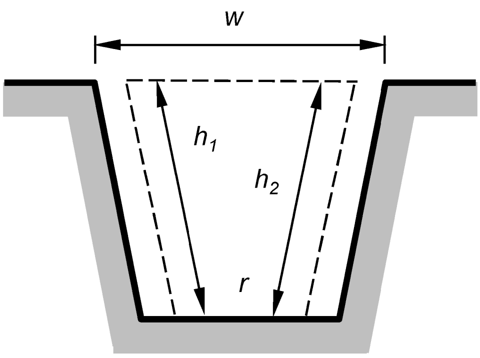
This method may be used to qualify noise reducing devices for other applications, e.g. to be installed nearby industrial sites. In this case the single-number ratings should be calculated using an appropriate spectrum.



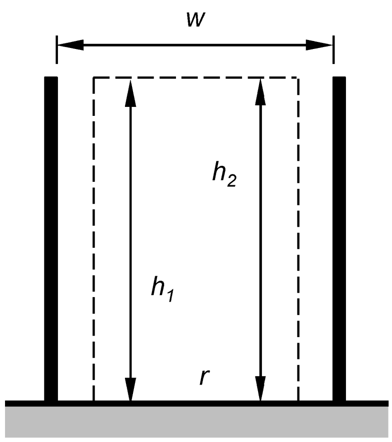
a) Partial cover on both sides of the road;
envelope, $e = w+h_1+h_2$



b) Partial cover on one side of the road;
envelope, $e = w+h_1$



c) Deep trench;
envelope, $e = w+h_1+h_2$



d) Tall barriers or buildings;
envelope, $e = w+h_1+h_2$

Key

r road surface

w width of open space

NOTE Figure 1 is not to scale.

Figure 1 — Sketch of the reverberant condition check in four cases

1 Scope

This European Standard specifies the laboratory method for measuring the sound absorption performance of road traffic noise reducing devices in reverberant conditions. It covers the assessment of the intrinsic sound absorption performance of devices that can reasonably be assembled inside the testing facility described in EN ISO 354.

This method is not intended for the determination of the intrinsic characteristics of sound absorption of noise reducing devices to be installed on roads in non-reverberant conditions.

The test method in EN ISO 354 referred to in this European Standard excludes devices that act as weakly damped resonators. Some devices will depart significantly from these requirements and in these cases, care is needed in interpreting the results.

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.

EN 1793-3, *Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 3: Normalized traffic noise spectrum*

EN ISO 354:2003, *Acoustics - Measurement of sound absorption in a reverberation room (ISO 354:2003)*

ISO 9613-1, *Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere*

3 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

Symbol or abbreviation	Designation	Unit
α_{NRDi}	Sound absorption coefficient in the i^th^ one-third octave band	-
A_1	Equivalent sound absorption area of the empty reverberation room	m^2
A_2	Equivalent sound absorption area of the reverberation room containing a test specimen	m^2
A_T	Equivalent sound absorption area of the test specimen	m^2
c_1	Propagation speed of sound in air in the empty reverberation room	ms^{-1}
c_2	Propagation speed of sound in air in the reverberation room with the test specimen during the measurement	ms^{-1}
$DL_{\alpha,NRD}$	Single-number rating of sound absorption performance expressed as a difference of A weighted sound pressure levels	dB
L	Length of the test panels on one side of the post	m
L_i	Normalized A weighted sound pressure level of traffic noise in the ith one-third octave band defined in EN 1793–3	dB

Symbol or abbreviation	Designation	Unit
m_1	Power attenuation coefficient calculated according to ISO 9613-1 using the climatic conditions that have been present in the empty reverberation room during the measurement. The value of m can be calculated from the attenuation coefficient, α, which is used in ISO 9613-1	m^{-1}
m_2	Power attenuation coefficient calculated according to ISO 9613-1 using the climatic conditions that have been present in the reverberation room with the test specimen during the measurement. The value of m can be calculated from the attenuation coefficient, α, which is used in ISO 9613-1	m^{-1}
S	Area (of the floor of the reverberation room) covered by the test specimen	m^2
T_1	Reverberation time of the empty reverberation room	s
T_2	Reverberation time of the reverberation room after the test specimen has been introduced	s
V_1	Net volume of the empty reverberation room	m^3
V_2	Net volume of the reverberation room containing a test specimen	m^3
V_s	Net volume of the test sample	m^3

4 Test arrangement

The test arrangement shall be as described in EN ISO 354, with the following modifications.

— The test specimen shall be assembled in the test chamber in the same manner as the manufactured device is used in practice, with the same connections and seals between the component parts.

— All the reflecting parts exposed on the road traffic side of the material (posts, brackets and other parts) shall be present on the specimen as in practice.

— Where posts are employed in construction, at least one post shall be included in the specimen with panels attached on both sides. The length of the panels on one side of the post shall be $L \geq 2$ m (Figures 2 and 3). The side that would face the road traffic shall face the inner part of the room (Figures 2 and 3). The post shall be sealed as in practice.

— The test specimen shall have a reflecting frame sealed against it on its entire perimeter and without any gap between the frame and the surface on which the test specimen is placed (Figures 2 to 6).

— The test specimen shall be placed directly against one of the surfaces (floor, wall or ceiling) of the chamber without any gap (Figures 2, 3 and 4). A dense filling material, such as sand or concrete (density > 200 kg/m³), shall always be inserted between the panels and chamber surface to completely fill all gaps.

— If the sample under test includes a plenum as part of the design, this shall be reproduced in the reverberation room and reported in the test report. If the sample under test includes a plenum that is not a design feature, the plenum shall be completely filled with a dense filling material such as sand or concrete.

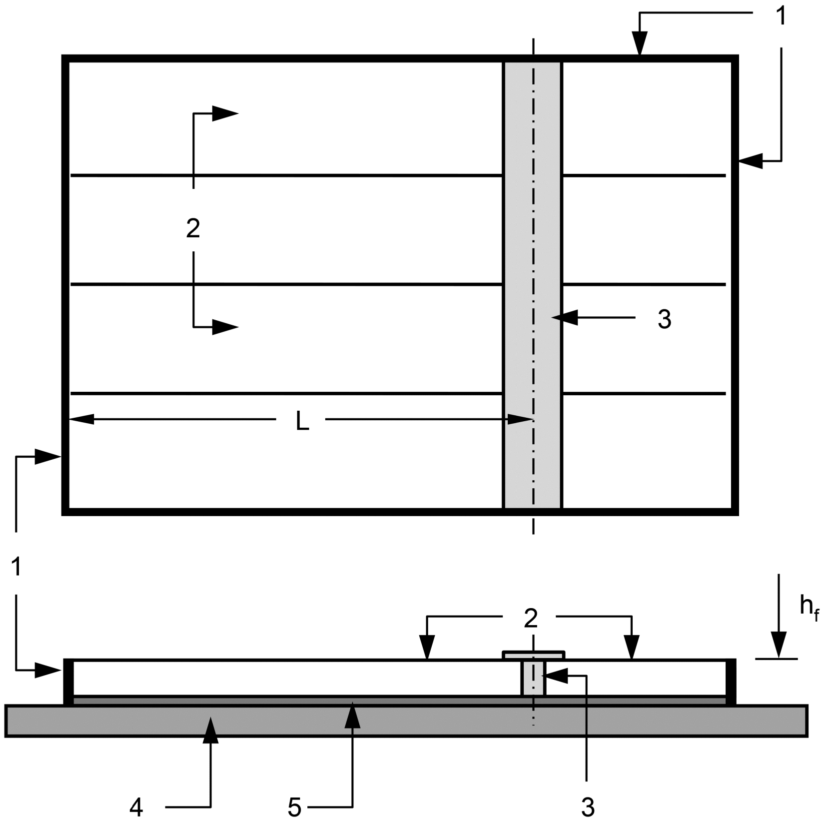
— If the sample under test includes a post, it is recommended to cut it to fit the panel thickness.

— If the sample under test includes a post having a thickness larger than that of the acoustic elements and protruding toward the interior of the test chamber, the reflective area created by the post fitting the acoustic elements shall be reproduced covering it by reflective strips (Figure 5). Alternatively, a T-shaped element with the same width of reflective surface as the visible face of the post can be used to replace the post.

— If the sample under test includes a post having a thickness larger than that of the acoustic elements and protruding toward the floor of the test chamber, the cavities created by the post under the acoustic elements shall be completely filled with a dense filling material such as sand or concrete (Figure 6). Alternatively a T-shaped element with the same width of reflective surface as the visible face of the post can be used to replace the post.

— Any combination of the conditions above may be applied in order to be sure that no cavities, gaps or plenum exist between the sample under test and the chamber surface unless explicitly prescribed for the device in its normal use.

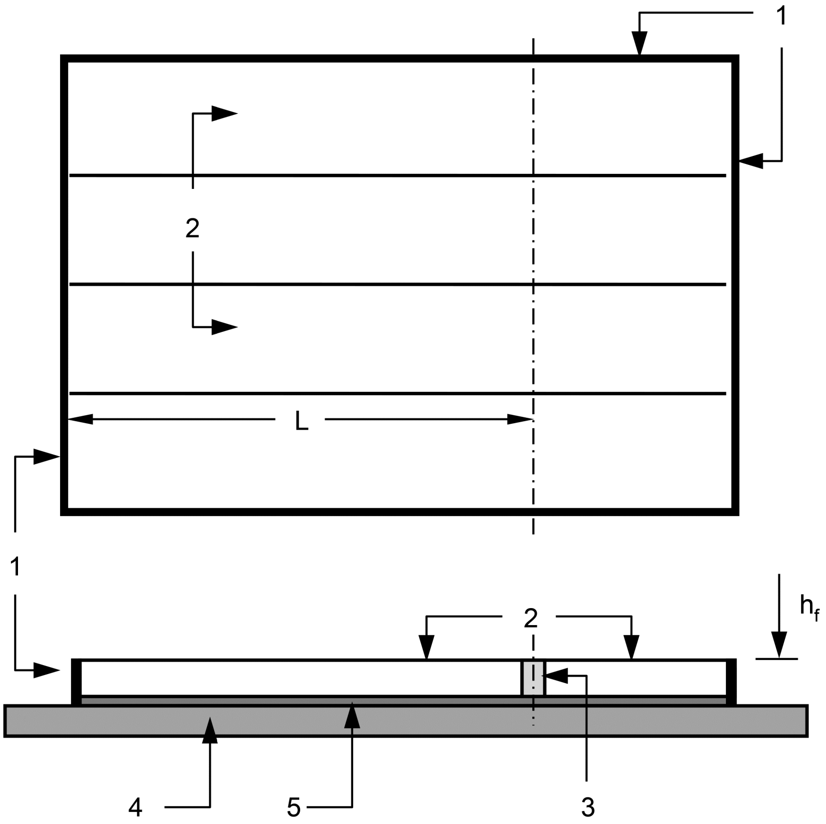
— For testing absorptive cladding for use on retained cuttings, tunnel walls and other reflective surfaces, the specimen shall be mounted against one of the surfaces of the chamber leaving the same gap and using the same components as proposed for the actual construction. In this case, the mounting conditions and components, e.g. the distance between the back of the sample and the surface of the chamber, shall be clearly reported.



Key

1	reflective frame	h_f	height of reflective frame
2	panels	L	length of the test panels on one side of the post
3	post		
4	chamber surface (floor)		
5	dense filling material		

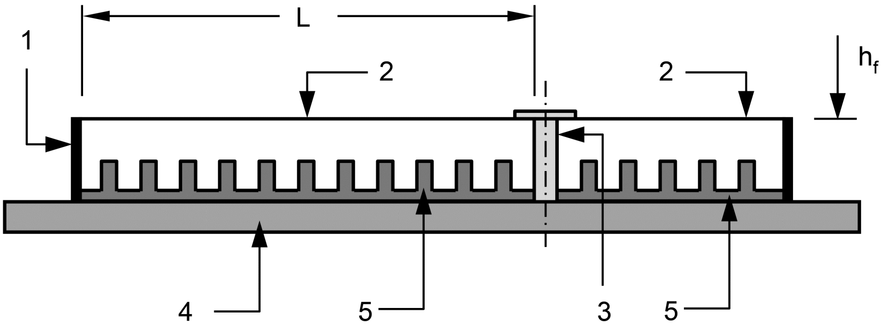
Figure 2 — Illustration of sample arrangement for devices having visible posts



Key

1	reflective frame	h_f	height of reflective frame
2	panels	L	length of the test panels on one side of the post
3	post		
4	chamber surface (floor)		
5	dense filling material		

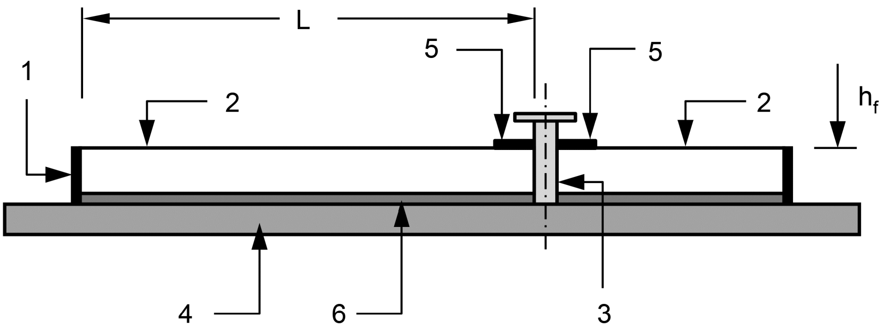
Figure 3 — Illustration of a flat sample arrangement having no visible posts and where there are no designed cavities on the floor/wall facing side of the test sample



Key

1	reflective frame	h_f	height of reflective frame
2	panels	L	length of the test panels on one side of the post
3	post		
4	chamber surface (floor)		
5	filler (concrete)		

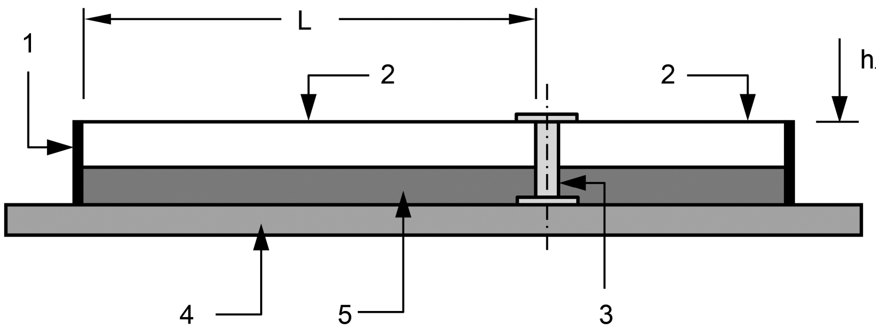
Figure 4 — Illustration of a non-flat sample arrangement directly against one of the surfaces (floor, wall or ceiling) of the chamber without any gap



Key

1	reflective frame	h_f	height of reflective frame
2	panels	L	length of the test panels on one side of the post
3	post		
4	chamber surface (floor)		
5	reflective strips		
6	dense filling material		

Figure 5 — Illustration of sample arrangement for devices having posts with a thickness larger than that of the acoustic elements and protruding toward the interior of the test chamber



Key

1	reflective frame	h_f	height of reflective frame
2	panels	L	length of the test panels on one side of the post
3	post		
4	chamber surface (floor)		
5	dense filling material		

Figure 6 — Illustration of sample arrangement for devices having posts with a thickness larger than that of the acoustic elements and protruding toward the floor of the test chamber

5 Test procedure and evaluation

5.1 Test method

The sound absorption coefficients α_{NRDi} in each one-third octave band in the range 100 Hz to 5 kHz shall be determined using the method described in EN ISO 354 with the following modification:

The equivalent sound absorption area of the test specimen, AT in square metres, shall be calculated using Formula (1):

$$A_T = A_2 - A_1 \quad (1)$$

where

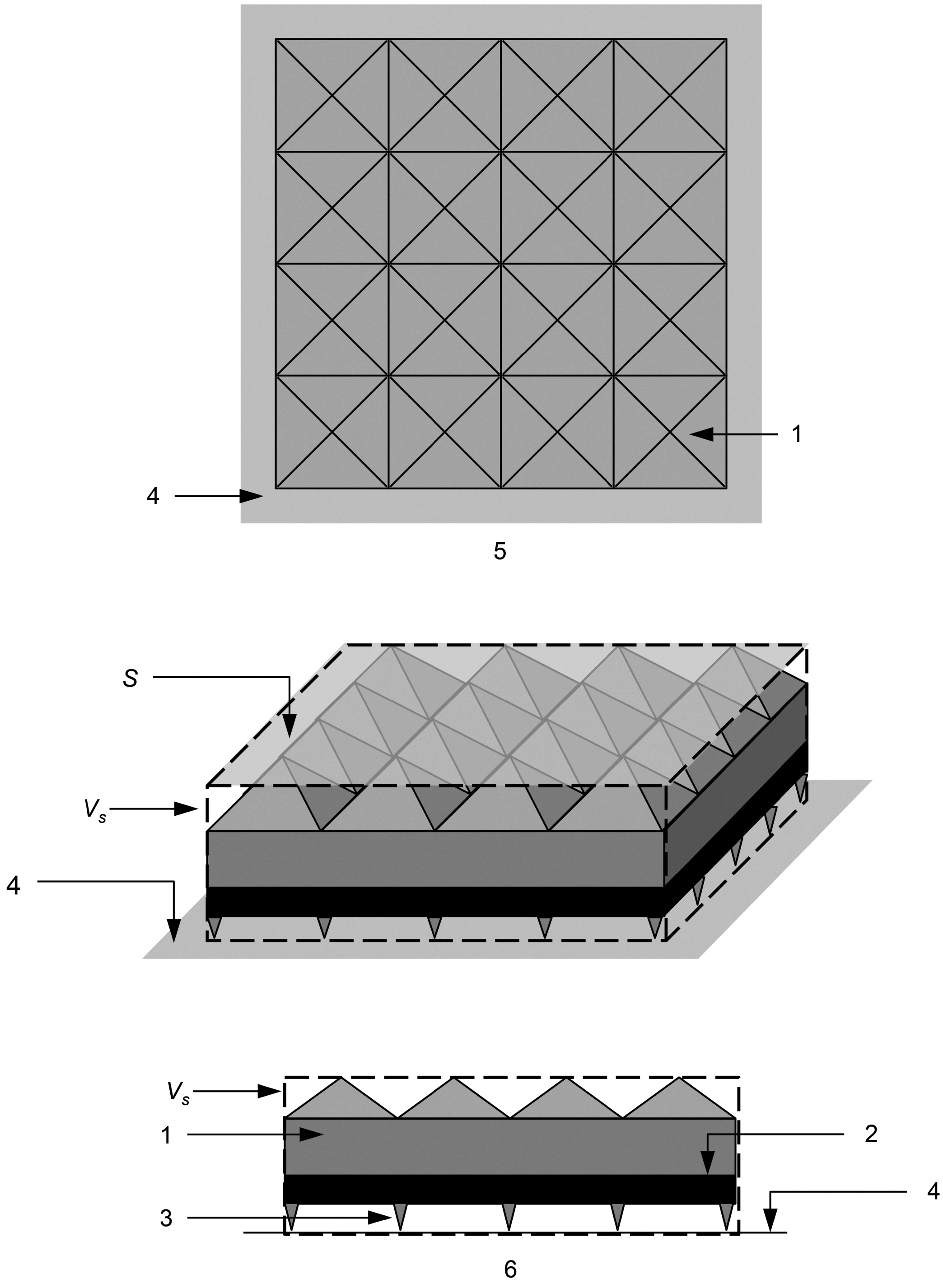
$$A_1 = \frac{55,3V_1}{c_1T_1} - 4V_1m_1 \quad (2)$$

$$A_2 = \frac{55,3V_2}{c_2T_2} - 4V_2m_2 \quad (3)$$

and

$$V_2 = V_1 - V_S \quad (4)$$

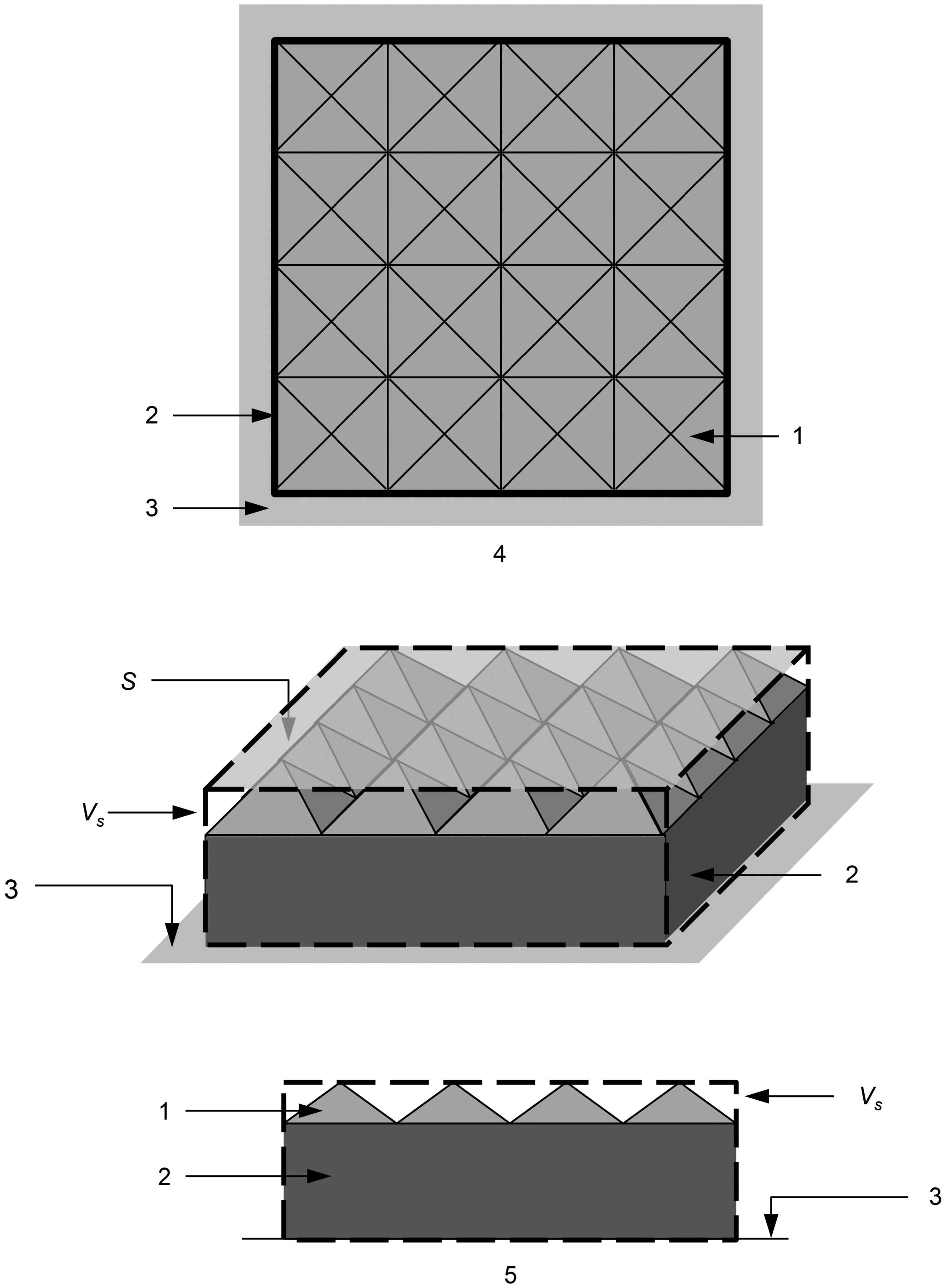
where V_s is the volume of the envelope of the test sample and the reflective frame (see Figure 7).



Key

1	absorptive test sample	V_s	net volume of test sample
2	support	5	plan view of test arrangement
3	plenum	6	cross-section of test arrangement
4	chamber surface (floor)		
S	area of floor covered by test sample		

Figure 7 — Definition of V_s and S for a test sample (shown without the obligatory frame)



Key

1	absorptive test sample	S	area of floor covered by test sample
2	obligatory frame	V_s	net volume of test sample
3	chamber surface (floor)	5	cross-section of test arrangement
4	plan view of test arrangement		

Figure 8 — Definition of V_s and S for a test sample (shown with the obligatory frame)

The sound absorption coefficient α_{NRDi} of the test specimen in the ith one-third octave band shall be calculated using Formula (5):

$$\alpha_{\mathrm{NRD}} = \frac{A_T}{S} \tag{5}$$

where A_T and S are as defined in Clause 3.

If an existing test has been performed following the requirements of previous versions of EN 1793-1, α_{NRD} can be derived from reported results.

5.2 Single number rating of sound absorption $DL_{\alpha,NRD}$

A single-number rating shall be derived to indicate the performance of the product. The individual sound absorption coefficients shall be weighted according to the normalized traffic noise spectrum defined in EN 1793-3.

The single-number rating of sound absorption $DL_{\alpha,NRD}$, in decibels, is given by Formula (6):

$$DL_{\alpha,\mathrm{NRD}} = -10 \lg \left| 1 - \frac{\sum_{i=1}^{18} \alpha_{\mathrm{NRD}i}\, 10^{0,1\, L_i}}{\sum_{i=1}^{18} 10^{0,1\, L_i}} \right| \tag{6}$$

where

$DL_{\alpha,NRD}$ is the single-number rating of sound absorption performance expressed as a difference of A weighted sound pressure levels, in decibels;

α_{NRDi} is the sound absorption coefficient in the i^{th} one-third octave band;

L_i is the normalized A weighted sound pressure level, in decibels, of traffic noise in the i^{th} one-third octave band defined in EN 1793–3.

In some cases, the ratio of the summations term in the expression of $DL_{\alpha,NRD}$ can exceed 1 which precludes the calculation of $DL_{\alpha,NRD}$. For this reason, the maximum value of this ratio shall be limited to 0,99.

NOTE Annex A provides guidance on the use of the single-number rating.

6 Test report

6.1 Expression of results

The one-third octave band values of the sound absorption coefficients α_{NRDi} shall be given at all frequencies of measurement in tabular form and in the form of a graph. The coefficients shall be rounded to the nearest second decimal place.

The single-number rating of sound absorption $DL_{\alpha,NRD}$ shall be reported after being rounded to the nearest integer.

6.2 Further information

The test report shall include the information listed below:

a) reference to this European Standard;

b) name and address of testing organization;

c) date of the test;

d) detailed description of the sample under test including dimensions (including test sample volume and surface area) and photographs;

e) detailed description of the test conditions including dimensions; floor or wall mounting; plenum; frames; procedures and equipment used in accordance with EN ISO 354;

f) photographs of the sample under test conditions with and without frames;

g) full description of the test specimen including manufacturer's name and product identifier with sectional drawings and photographs showing mounting conditions; masses, densities, dimensions and specifications of panels, posts and seals, including any internal components;

h) name and address of the organization which performed the measurements;

i) signature of the person responsible for the measurements.

Annex A
(informative)

Guidance note on the use of the single number rating $DL_{\alpha,\mathrm{NRD}}$

The use of the single-number rating $DL_{\alpha,\mathrm{NRD}}$ is solely for the purposes of comparing the overall performance of noise reducing devices, irrespective of local conditions, traffic composition and road surface type.

The basis of this guidance is that the road traffic noise spectrum as defined in EN 1793-3 is most directly relevant to characterizing the absorptive performance of noise reducing devices in situations where the sound radiated by the traffic stream and reflected by the absorptive surface travels directly to the receiver position without having undergone further reflections from other surfaces or having been diffracted from barrier edges or obstacles.

Under reverberant conditions multiple reflections will occur. The spectrum may therefore be altered so that the low-frequency components can be emphasized at the barrier surface.

Therefore, in reverberant conditions, the performance of noise reducing devices should be considered as a function of frequency using the one-third octave band results.

Annex B
(informative)

Measurement uncertainty

B.1 General

The accepted format for expression of uncertainties generally associated with methods of measurement is that given in the ISO Guide to the Expression of Uncertainty in Measurement (ISO/IEC Guide 98-3). This format incorporates an uncertainty budget, in which all the various sources of uncertainty are identified and quantified, and from which the combined total uncertainty can be obtained. The data necessary to enable such a format to be adopted in the case of this European Standard are the same as for EN ISO 354 because the measurement procedure is the same (see Clause 5). Therefore reference shall be made to EN ISO 354 and related treatment of the measurement uncertainty.

B.2 Measurement uncertainty based upon reproducibility data

The information on measurement reproducibility can be helpful towards the derivation of measurement uncertainties, but it is incomplete. In particular, it does not give an analysis of the various components of measurement uncertainty and their magnitudes. In the absence of data for uncertainty contributions, values for the standard deviation of reproducibility, when available, may be used as an estimate of the combined standard uncertainty of determinations of sound absorption coefficient. A value may then be selected for the coverage factor, and the product of the two will yield an estimate of the expanded measurement uncertainty, with the chosen coverage probability. By convention, a coverage probability of 95 % is usually chosen. To avoid any misinterpretations, the chosen coverage probability should always be stated in test reports together with the expanded measurement uncertainty.

Annex C
(informative)

Example test report

IMPORTANT Logically, when drafting a test report using the template below, all references to Annex C shall be removed.

C.1 Overview

For product XXXX produced by the firm YYYY

Remark:	The present test is based on the test method according to EN 1793–1.
Test object:	
Manufacturer:	
Product identifier/type:	
Dimensions:	See the detailed description of the sample under test including (sectional) drawings and photographs in C.2, showing masses, densities, dimensions (including the volume and surface area of the test sample) and specifications of panels, posts and seals, including any internal components
Test situation:	
Test room:	See detailed description of the reverberant room in C.3
Test arrangement:	See detailed description of plenum, frames and mounting on floor or wall in C.3 with photos with/without frames
Test equipment and procedures:	See detailed description of equipment and procedures used in accordance with EN ISO 354 in C.3
Test conditions:	See details in C.3
Test results:	See Table C.3 and Figure C.3 in C.4
Single number rating:	The single number rating for the sound absorption amounts to $DL_{\alpha,NRD}$ = ______ dB
Date of test:	
Name and address of the testing organization:	
Signature of the person responsible for the measurements:	Name: Place, date: ______________________________ Signature

C.2 Test object (example)

The test object was composed of 4 double-sided absorptive test specimens of 3 000 mm × 1 000 mm × 122 mm. The total volume of the test specimens was 1 464 m^3 and the surface area was 12 m^2.

The weight of the elements was determined, and a weight per unit area of m” = 30,5 kg/m^2 was calculated. The length-related flow resistance provided by the manufacturer is r > 60 kPa·s/m^2.

The structure of a single element in the test set-up was as follows:

- 8,4 mm round steels in cross direction, axis-centre distance 144 mm;
- 6,4 mm round steels in longitudinal direction, axis-centre distance 200 mm;
- 2 mm geotextile, weight per unit area approximately 350 g/m^2;
- 55 mm rock wool insulating mat, density approximately 160 kg/m^3;
- 55 mm rock wool insulating mat, density approximately 160 kg/m^3;
- 2 mm geotextile, weight per unit area approximately 350 g/m^2;
- 6,4 mm round steels in longitudinal direction, axis-centre distance 200 mm;
- 8,4 mm round steels in cross direction, axis-centre distance 144 mm;
- reverberation room floor.

The test object is represented in the following drawings (see Figure C.1).

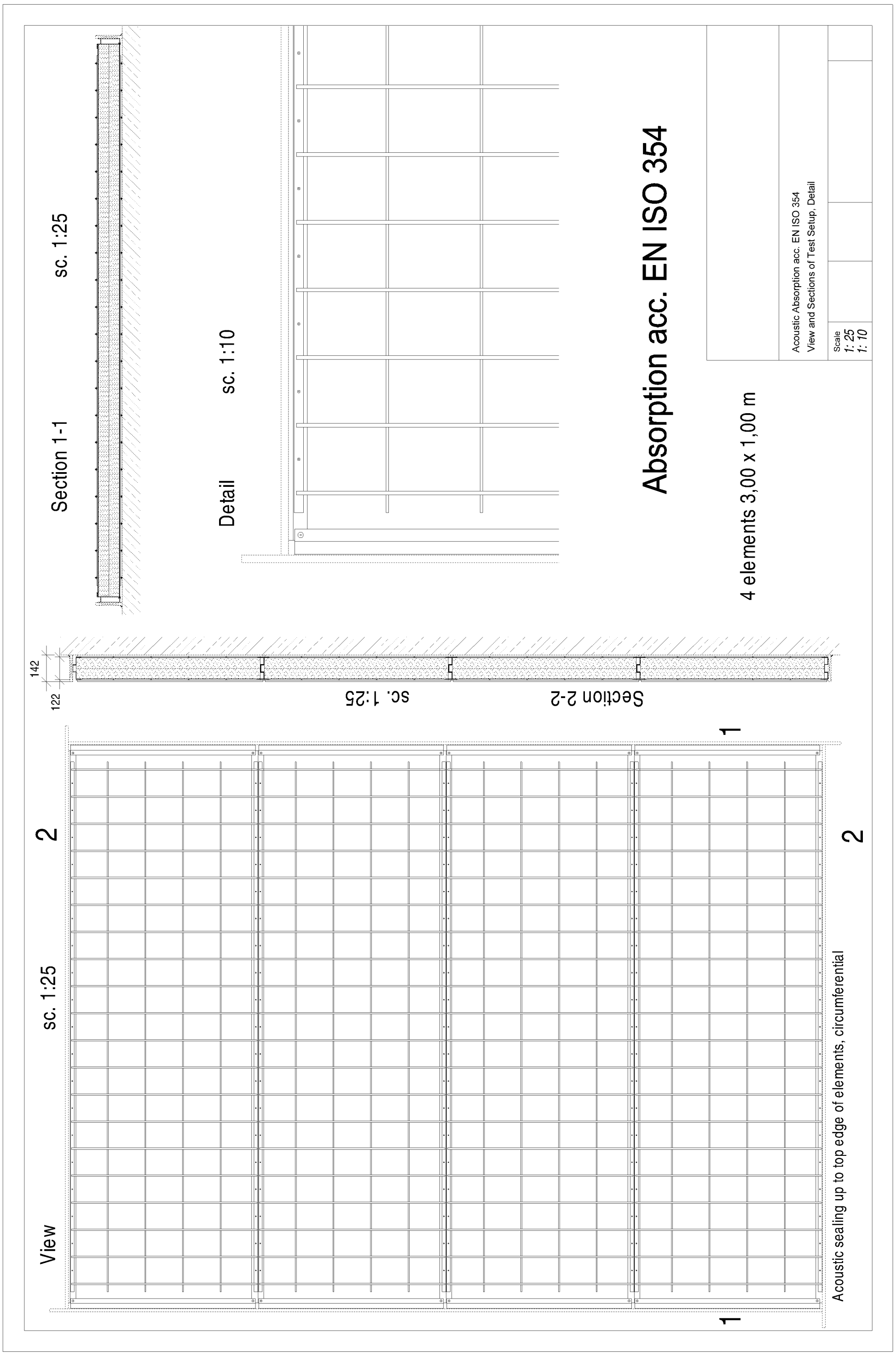


Figure C.1 — Test object

C.3 Test situation (example)

C.3.1 Test room and test arrangement

The reverberation room has a volume of approximately 195 m³ and a surface area of approximately 205 m². The rectangular reverberation room has the following dimensions: length 7,15 m, width 6,05 m and a mean height of 4,5 m. To increase diffusivity, 19 curved pieces of plywood of 1 m^2 each were suspended in the reverberation room as diffusers at irregular distances.

The test arrangement of 12 m^2 was laid to fit the reverberation room floor (type A, EN ISO 354:2003, B.2), whereas the elements were set close. The edges were not parallel to the closest edge of reverberation room. A planed plank with a thickness of 25 mm and a height of 125 mm was installed to cover the peripheral edge of test arrangement. The groove between frame strips and reverberation room floor was sealed using by permanently plastic joint sealant.

A sheet metal plate with a width of 160 mm was installed on the smooth surface of the test body according to Clause 4 to simulate the post.

The test room and the test arrangement are shown in Figure C.2.

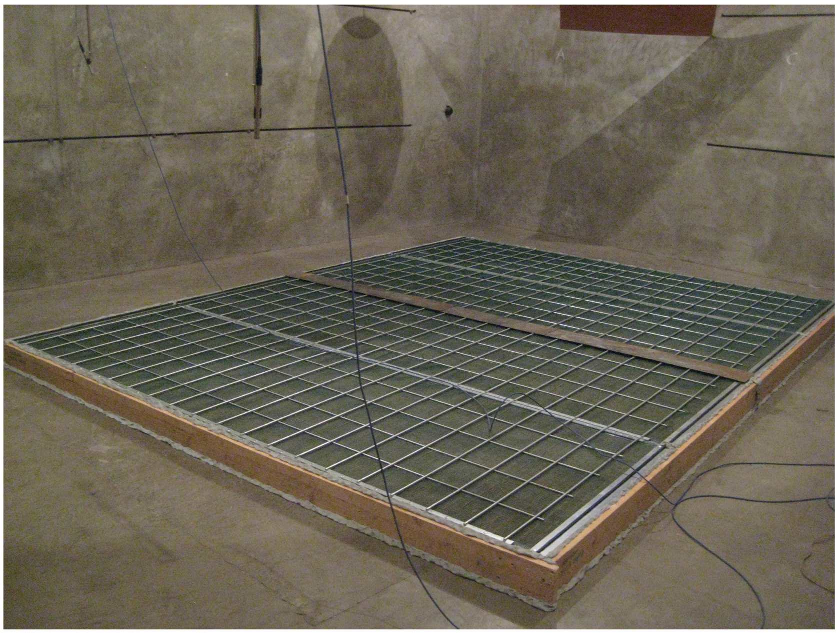


Figure C.2 — Test arrangement in reverberation room

C.3.2 Test equipment and test procedures

The following measuring instruments listed in Table C.1 were used:

Table C.1 — Measuring instruments

Device	Type	Brand
Real time analyser with noise generator	xxx	yyy
Free field microphone	xxx	yyy
Pre-amplifier	xxx	yyy
Calibration unit	xxx	yyy
Output amplifier	xxx	yyy
Loudspeaker combination (Dodecahedron)	xxx	yyy

The measuring instruments are calibrated at regular intervals and the measuring chain is calibrated prior to and after each measurement. The testing laboratory participates regularly at the reference measurements for test boards (suitability test boards).

The acoustic absorption coefficient was determined out of the reverberation times before and after insertion of test object into reverberation room. A broadband noise was used as test signal. In all frequency bands, the measurements were carried out with 4 different microphone positions and 3 different loudspeaker positions. A total of 36 decay curves were analysed.

C.3.3 Test conditions

The climatic conditions during the measurements were as detailed in Table C.2.

Table C.2 — Climatic conditions

	Air temperature	Humidity	Static pressure
Empty reverberation room	18 °C	29,5 %	1 020 hPa
Reverberation room with test specimen	18 °C	31 %	1 020 hPa

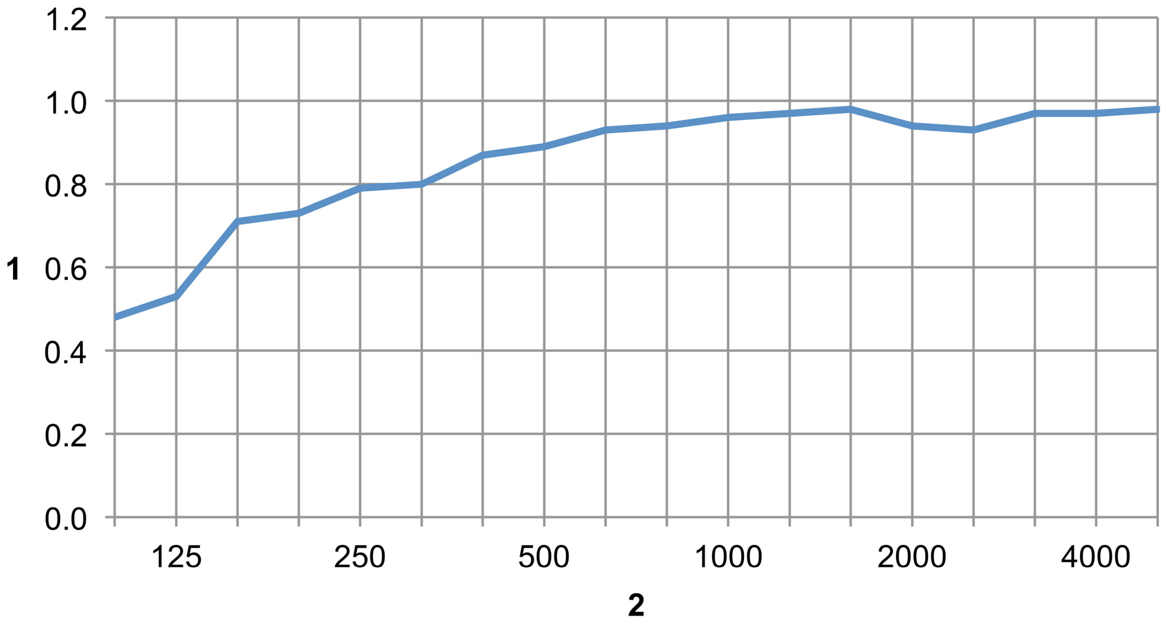
C.4 Test results (example)

Table C.3 shows for every test frequency band f the measured reverberation time T with and without the test specimen, and the resulting absorption coefficient α_{NRD}:

Table C.3 — Test results (example)

f in Hz	100	125	160	200	250	315	400	500	630	800	1 000	1 250	1 600	2 000	2 500	3 150	4 000	5 000
T in s without	9,93	11,4	8,93	9,46	9,01	9,36	9,05	8,75	8,17	7,62	6,77	6,03	5,34	4,35	3,74	3,05	2,36	1,87
T in s with	3,52	3,44	2,63	2,59	2,43	2,43	2,27	2,21	2,11	2,04	1,96	1,88	1,8	1,71	1,63	1,46	1,29	1,13
α_{NRD}	0,48	0,53	0,71	0,73	0,79	0,80	0,87	0,89	0,93	0,94	0,96	0,97	0,98	0,94	0,93	0,97	0,97	0,98

The following graph (Figure C.3) shows the absorption coefficients as a function of frequency:



Key

1 sound absorption coefficient in α_{NRD}

2 frequency *f* in Hz

Figure C.3 — Absorption coefficients as a function of frequency

The single number rating for the sound absorption amounts to $DL_{\alpha,NRD}$ = 11 dB.

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