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Acoustics — Screens, furniture and single objects intended for interior use — Rating of sound absorption and sound reduction of elements based on laboratory measurements

Acoustique — Meubles, écrans et objets uniques destinés à usage intérieur — Note de l'absorption acoustique et de réduction acoustique des éléments basée sur des mesures en laboratoire

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The interior design industry is progressing rapidly, and the acoustic characteristics of products have become an important technical aspect in the design of new products. Currently, interior design products are generally not well defined in terms of their acoustic characteristics, often leading to confusing and misleading product specifications and marketing materials. Further, it is often unclear how a product's reported acoustic characteristics are to be applied to determine its acoustic impact in a furnished room.

This document is intended to clarify the acoustic characteristics, and their application, for various interior design products. This is accomplished by a standardized test methodology for the measurement of sound absorption, and defining when an interior product is to be considered as a single object.

This document is intended to facilitate the measurement and evaluation procedure for any interior product currently on the market. By using it, different interior design products can be compared to each other in an equal manner. Additionally, product acoustic characteristics evaluated according to this document can be applied for room acoustic modelling and calculations.

Acoustics — Screens, furniture and single objects intended for interior use — Rating of sound absorption and sound reduction of elements based on laboratory measurements

1 Scope

This document specifies how screens, furniture and single objects intended for interior use are assessed with regard to sound absorption and specifies the evaluation of sound attenuation for floor screens. It also specifies under which circumstances various interior products for offices, schools and other public spaces are considered as plane absorbers or as discrete single objects. A product considered as a single object and intended for interior use is measured according to ISO 354 and evaluated by its equivalent sound absorption area or object sound absorption coefficient in octave bands. This document defines interior products and single objects and it comprises additional information regarding measurements and assessment of single objects.

The sound absorption as specified in this document can be used to calculate:

a) reverberation time characteristics in rooms;

b) room acoustic parameters using ray tracing software.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 354:2003, *Acoustics — Measurement of sound absorption in a reverberation room*

ISO 717-1:2013, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation*

ISO 10053, *Acoustics — Measurement of office screen sound attenuation under specific laboratory conditions*

ISO 10140-2, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation*

ISO 11654:1997, *Acoustics — Sound absorbers for use in buildings — Rating of sound absorption*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
interior acoustic product
object aimed for insertion loss and/or absorption of indoor sound

3.2
single object
interior acoustic product (3.1) with a defined size and normally mounted by itself, i.e. at some distance to the nearest other single object

Note 1 to entry: Single objects are sometimes mounted tightly together to form an array or a large homogeneous surface. Single objects do not have the same acoustic performance when considered in larger groups.

3.3
desk screen
single object (3.2) intended to be mounted vertically on the side of a table top

3.4
floor screen
single object (3.2) intended to stand vertically on the floor

3.5
furniture ensemble
setup of furniture and screens, connected sofas, or any other combination considered as a *single object* (3.2)

3.6
equivalent sound absorption area per single object
A_{obj}
frequency-dependent value for the equivalent sound absorption area

Note 1 to entry: Measurements are carried out according to ISO 354. When the test specimen comprises several identical single objects, A_{obj} is found by dividing A_T (equivalent sound absorption area of the test specimen as defined in ISO 354) by the number of single objects.

Note 2 to entry: It is used to describe a single object's ability to absorb sound.

Note 3 to entry: The unit is absorption area in m^2.

3.7
practical sound absorption coefficient
α_p
frequency-dependent value of the sound absorption coefficient which is based on measurements on one-third-octave bands in accordance with ISO 354 and which is calculated in octave bands

[SOURCE: ISO 11654:1997, 3.1, modified — "in accordance with this International Standard" and Note 1 to entry have been deleted.]

3.8
weighted sound absorption coefficient
α_w
frequency weighted single number value evaluated from the *practical sound absorption coefficients* (3.7)

Note 1 to entry: The weighting procedure is described in ISO 11654.

3.9
single object's absorption coefficient
α_{obj}
single object (3.2)'s frequency-dependent absorption coefficient in octave bands (for use in 3D simulations) based on the product's *equivalent sound absorption area,* A_{obj} (3.6)

Note 1 to entry: Examples of evaluation are given in Annex B.

3.10
screen sound attenuation
ΔL_S
floor screen (3.4) sound attenuation in different octave bands

Note 1 to entry: Measurements are carried out according to ISO 10053.

Note 2 to entry: For a screen with no air gap at the floor, ΔL_S is an approximation of the insertion loss that would have been obtained in a free field with a corresponding screen of infinite width and semi-infinite height.

3.11
weighted screen sound attenuation
$\Delta L_{S,W}$
single number value of the *screen sound attenuation* (3.10) weighted and evaluated from the measured octave band values

Note 1 to entry: The weighting procedure is described in ISO 10053.

3.12
sound reduction index
R
frequency-dependent measure describing how much sound energy is transmitted through a screen construction

Note 1 to entry: Measurements are carried out according to ISO 10140-2.

3.13
weighted sound reduction index
R_W
frequency weighted value evaluated from the frequency-dependent *sound reduction indexes* (3.12)

Note 1 to entry: The weighting procedure is described in ISO 717-1.

Note 2 to entry: Annex F gives additional information on which weighted sound reduction index it is reasonable to strive for depending on the screen height.

4 Methods to measure and evaluate various interior acoustic products

4.1 Single objects

4.1.1 General

Single objects are typically floor screens, desk screens, chairs, stools, desks, sofas or any other object that can absorb, scatter or spread sound within a room. They can also be unique products intended for wall application or for interior decoration, which have an added room acoustic effect.

Single objects are normally measured, evaluated and declared with regard to their sound absorption characteristics. For specific product categories or mounting conditions, additional acoustic characteristics may be measured and evaluated (see 4.3 and 4.5).

4.1.2 Single object sound absorption

The sound absorption of a single object is measured according to ISO 354 while additional specified mounting conditions are given in Annex E. The sound absorption of the object shall be given as the equivalent sound absorption area, A_{obj}, in the 1/3-octave bands between 100 Hz and 5 000 Hz and in

the octave bands 125 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz and 4 000 Hz, calculated according to Formula (1):

$$A_{obj,k} = \frac{\left(A_{obj,k1} + A_{obj,k2} + A_{obj,k3}\right)}{3} \quad (1)$$

where $A_{obj,kl}$ is the centre frequency of the 1/3-octave band within each k-th octave band. Hence, for a single object, the practical and weighted sound absorption coefficients are not evaluated (ISO 11654). However, the single object's sound absorption coefficient, α_{obj}, may be evaluated in addition to the single object's sound absorption, A_{obj}. The procedure to evaluate α_{obj} in octave bands (weighted value is not allowed) is given in Annex B.

4.2 Desk screens

Desk screens and similar single objects are measured and evaluated with regard to their sound absorption characteristics. The sound absorption of desk screens is measured according to 4.1.2 and evaluated according to Formula (1).

4.3 Floor screens

4.3.1 General

A floor screen is a room divider normally used in large rooms to provide sound attenuation between workstations or different zones with several workstations. A floor screen can have different heights and is normally comprised of several units standing on the floor, connected to create a space separation around one or more workstations. Single screen units can occur but are then not regarded as a screen but instead as a single object. A floor screen is normally higher than 1,4 m but lower than room height, leaving some space between the ceiling and its top.

Floor screens can be measured, evaluated and declared with regard to their sound absorption characteristics, their screen sound attenuation and sound insulation (sound reduction index).

4.3.2 Floor screen sound absorption

The sound absorption of a floor screen is measured according to 4.1.2 and evaluated according to Formula (1).

4.3.3 Floor screen sound attenuation

The sound attenuation of a floor screen is given as ΔL_s, and $\Delta L_{s,w}$ according to ISO 10053. The values are strongly dependent on the actual screen height and connections between units, and are therefore only applicable for the screen height and the connection setup that were valid during the measurements.

4.3.4 Floor screen sound insulation

The sound insulation of a floor screen is denoted with the frequency-dependent sound reduction index, R, and with the weighted sound reduction index, R_w. The sound reduction index is measured in a laboratory where the screen construction is mounted in the entire test opening according to ISO 10140-2. The sound reduction index is measured for the entire construction including connections to floor, walls and between individual screen elements. Connections between screen elements shall be performed as it is done in reality (normally). No extra sealing is allowed between adjacent screen elements. An edge of maximum 5 cm is allowed around the test specimen in order to simplify the mounting.

The sound reduction shall be measured in the 1/3-octave bands between 100 Hz and 5 000 Hz. The frequency range may be extended in order to comprise frequencies between 50 Hz, if possible.

4.4 Furniture ensembles

4.4.1 General

A furniture ensemble is a determined setup of a fixed set of interior products and furniture that creates a composite object, a combination of a desk with screens forming a workplace, a telephone booth, or similar. Furniture ensembles are normally aimed at creating a workstation with privacy and reducing speech transmission from the ensemble to the surroundings.

4.4.2 Furniture ensembles sound absorption

The sound absorption of a furniture ensemble is measured according to 4.1.2 and evaluated according to Formula (1).

4.5 Single objects that are tightly connected to form a surface greater than or equal to 10 m^2

Sound-absorbing single objects that are tightly connected forming a homogeneous surface larger than or equal to 10 m^2 are defined as large absorbing surfaces aimed to be applied on walls or any other plane surface. The sound absorption is then defined by the practical sound absorption coefficient according to ISO 11654.

4.6 Other single objects

Any other single object such as lamps, lighting devices, others 3D-objects, art objects, etc. that cannot be classified as defined in 4.2 to 4.5 shall be treated according to 4.1.2.

5 Statement of results

5.1 Results for sound absorption

The test specimen including the interior product shall be described, including its mounting conditions. It shall be clearly stated how the sound absorbing surfaces (if any) and frames are distributed on the tested objects.

The test conditions shall be indicated, including the number of objects in the test specimen and their locations in the reverberation chamber. The volume of the reverberation chamber and its treatment with diffusors shall be given in the report, as described in ISO 354. Mounting conditions for various test specimen are given in Annex E.

The test specimen shall meet the requirements for sample sizes in ISO 354. If any deviations occur, an explanation shall be given as to why they have been made.

α_{obj} can be evaluated for the product, if applicable. The use of α_p and α_w is only allowed for single objects that are tightly connected to form a surface greater than 10 m^2, as specified in 4.5.

5.2 Results for floor screen sound attenuation

The test specimen including the interior product shall be described, including measurement and mounting preconditions according to the rules given in ISO 10053. All connections between screen elements and mounting conditions shall be presented.

Any deviations from ISO 10053 shall be reported including an explanation on why they have been made.

5.3 Results for sound insulation

The test specimen including the product shall be described, including measurement and mounting preconditions according to the rules given in ISO 10140-2. All connections between screen elements and mounting conditions shall be presented.

Potential deviations from ISO 10140-2 shall be reported including an explanation on why they have been made.

5.4 Other information to be reported

The test report shall also include:

a) the name and address of the laboratory that has performed the measurements;

b) the identification number of the test/evaluation report;

c) the name and address of the organization that has ordered the measurement and the evaluation;

d) the name and address of the manufacturer of the tested product;

e) the name or any other identification of the tested product;

f) a detailed description of the test specimen, including the specimen's dimensions;

g) the date when the test was carried out;

h) measurement information according to the specifications in ISO 354;

i) test results according to:

   1) Annex A for measurement of equivalent sound absorption area of single objects, including mounting conditions according to Annex E;

   2) Annex B for evaluation of α_{obj} (if applicable);

   3) Annex C for measurement of screen sound attenuation of floor screens (if applicable), ISO 10053;

   4) Annex D for measurement of sound reduction of a screen (if applicable);

   5) ISO 11654 for measurement of draperies, curtains and an array of single objects or tightly connected to surfaces with a size larger than or equal to 10 m^2;

j) the date and signature of the person who was responsible for the test;

k) a reference to this document, i.e. ISO 20189:2018.

Annex A
(normative)

Presentation of equivalent sound absorption area

The equivalent sound absorption area per single object is presented as given in Table A.1 and Figure A.1 in m^2 according to the following:

a) In the 1/3 octave bands from 100 Hz to 5 000 Hz, the values shall be rounded to 0,1 m^2. Data from the 1/3 octave bands 50 Hz, 63 Hz and 80 Hz are optional.

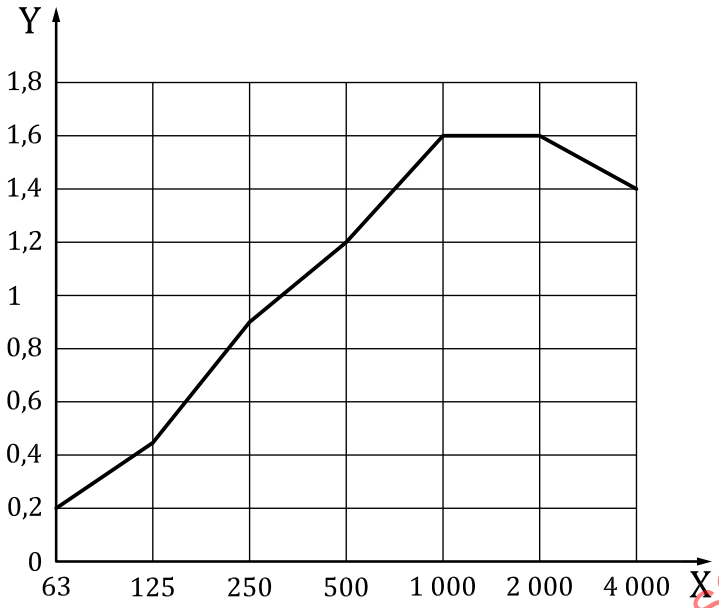
b) In the octave bands between 125 Hz to 4 000 Hz, the values shall be rounded to 0,1 m^2. However, if the highest measured equivalent sound absorption area is less than 1,0 m^2, two decimals shall be applied for all octave bands. Data from the octave band 63 Hz is optional.

NOTE 1 This is not contradictory to the measurement uncertainty of ISO 354 since there is a requirement in ISO 354 regarding the minimum added equivalent sound absorption area. If the objects have small equivalent sound absorption areas, more objects are needed in the test specimen compared to objects with large equivalent sound absorption area.

NOTE 2 It is important to be aware of the high uncertainty in the results from 63 Hz.

Table A.1 — Example of presentation of equivalent sound absorption area

1/3 octave band Hz	Equivalent sound absorption area/object m^2	
	1/3 octave band	octave band
50	Optional	
63	Optional	Optional
80	Optional	
100	0,4	
125	0,5	0,5
160	0,6	
200	0,6	
250	0,9	0,9
315	1,2	
400	1,1	
500	1,2	1,2
630	1,3	
800	1,4	
1 000	1,6	1,6
1 250	1,8	
1 600	1,8	
2 000	1,6	1,6
2 500	1,4	
3 150	1,4	
4 000	1,4	1,4
5 000	1,4	



Key

X frequency, in Hz

Y equivalent sound absorption area, in m^2

Figure A.1 — Example of presentation of equivalent sound absorption area

Annex B
(normative)

Examples for the deduction of object sound absorption coefficient, α_{obj}

B.1 General

Room acoustic modelling software uses simplified 3D geometries to represent rooms and interior objects. All surfaces in such models are plane and are required to be described by their acoustic properties, such as absorption, scattering or transmission. In general, the input to the acoustic modelling software is not the absorption area, A_{obj}, and all surfaces, including the furnishings, are approximated by planes. As such, the sound absorption of a single object is given by a sound absorption coefficient that relates to the geometry used to approximate the single object. The single object sound absorption coefficient in the octave band k, $\alpha_{obj,k}$, is defined according to:

$$\alpha_{obj,k} = A_{obj,k} / S$$

where

$A_{obj.k}$ is the equivalent sound absorption area in octave bands according to 4.1.2;

S is the total exposed surface area of the simplified acoustic representation of the single object in the laboratory measurement for the actual mounting condition.

NOTE x,y2 is rounded to x,y0 and x,y3 is rounded to x,y5. x,y7 is rounded to x,y5 and x,y8 is rounded to x,y+0,1.

Measured values with an object close to a wall are normally different from measured values with the object standing freely in the central area of the reverberation room (see Annex E for more information on different mounting conditions).

The simplified acoustic representation should be a cuboid. The size of the cuboid is similar to the smallest possible cuboid that enfolds the object. Disregard objects that are smaller than 10 mm in one dimension. The actual position of the object in the 3D model affects which equivalent sound absorption area should be used with respect to mounting conditions.

α_{obj} is always evaluated using the cuboid as described in this annex, based on measurements for objects mounted according to Annex E (mandatory mounting conditions).

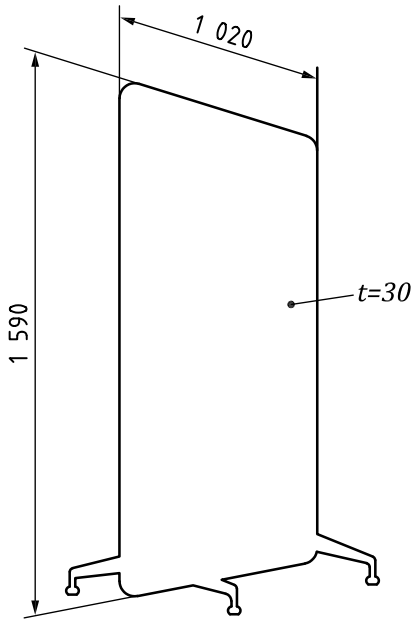
B.2 Example for a desk screen or a floor screen

In the example below, a floor screen is shown; however, the same rules are to be applied for a desk screen.

A floor screen with the dimensions 1,02 m × 1,59 m × 0,03 m measured for sound absorption in a reverberation chamber is found to have the following sound absorption area in the various octave bands:

Frequency, Hz	125	250	500	1 000	2 000	4 000
A_{obj}, m^2	0,6	0,8	1,3	1,6	1,8	2,1

All dimensions in millimetres



Key

t thickness

Figure B.1 — Example for a floor screen (desk screen is similar)

In order to evaluate α_{obj}, the total exposed surface of the smallest cuboid, S, is then calculated according to the following:

$$S = 2\times1{,}02\times0{,}03 + 2\times1{,}02\times1{,}59 + 2\times1{,}59\times0{,}03 = 3{,}4\ \text{m}^2$$

Using this surface, the sound absorption coefficient for the object becomes:

Frequency, Hz	125	250	500	1 000	2 000	4 000
α_{obj}	0,20	0,25	0,40	0,45	0,55	0,60

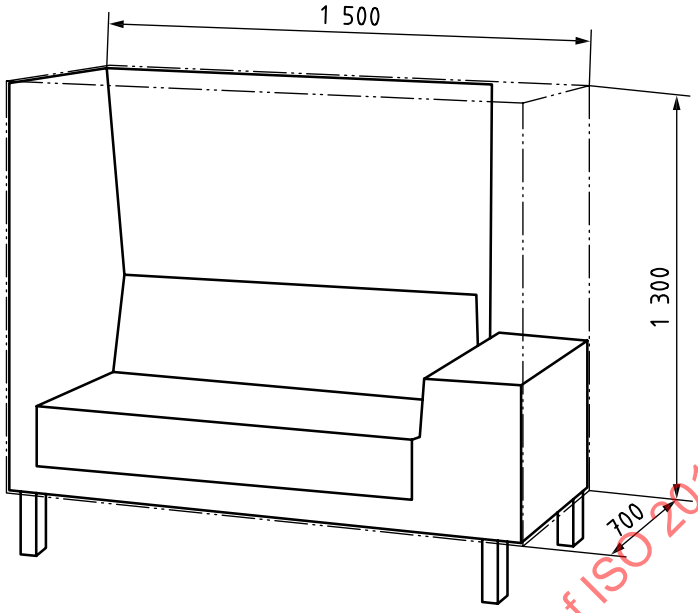
B.3 Example for a furniture ensemble, sofas, chairs and similar

In the example below, a sofa is shown; however, the same rules are to be applied for furniture ensembles, chairs and similar.

A sofa with the dimensions 1,50 m × 1,30 m × 0,70 m measured for sound absorption freely standing in a reverberation chamber is found to have the following sound absorption area in the various octave bands:

Frequency, Hz	125	250	500	1 000	2 000	4 000
A_{obj}, m^2	2,0	2,0	2,3	2,6	3,3	4,3

All dimensions in millimetres



NOTE Furniture assembly and chairs, etc. are similar.

Figure B.2 — Example for a sofa

To evaluate α_{obj}, the total exposed surface of the smallest cuboid, S, is then calculated according to:

$$S = \mathbf{2} \times 1{,}50 \times 0{,}70 + 2 \times 0{,}70 \times 1{,}30 + 2 \times 1{,}50 \times 1{,}30 = 7{,}82\ \text{m}^2$$

If the object is resting directly on the floor or is less than 100 mm from the floor, the bottom surface area is omitted. In this case, the number "2" indicated in bold in the above is replaced with the number "1".

Using this surface area, the sound absorption coefficient for the object becomes:

Frequency, Hz	125	250	500	1 000	2 000	4 000
α_{obj}	0,25	0,25	0,30	0,35	0,40	0,55

B.4 Example for a cupboard or a bookshelf

A cupboard with the dimensions 1,15 m × 0,60 m × 1,75 m measured for sound absorption freely standing in a reverberation chamber is found to have the following sound absorption area in the various octave bands:

Frequency, Hz	125	250	500	1 000	2 000	4 000
A_{obj}, m^2	1,9	2,1	2,6	1,6	1,3	1,3

All dimensions in millimetres

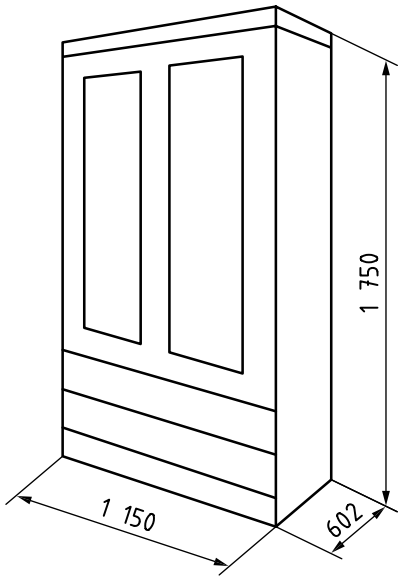


Figure B.3 — Example for a cupboard

To evaluate α_{obj}, the total exposed surface of the smallest cuboid, S, is then calculated according to the following:

$$S = 2\times1{,}15\times1{,}75 + 2\times1{,}75\times0{,}60 + 1\times1{,}15\times0{,}60 = 6{,}82\ \text{m}^2$$

Note that the bottom surface area of the cupboard is omitted in the calculation of S. Using the cuboid surface area, the sound absorption coefficient for the object becomes:

Frequency, Hz	125	250	500	1 000	2 000	4 000
α_{obj}	0,30	0,30	0,40	0,25	0,20	0,20

B.5 Example for volume element

A volume element has the dimensions 2,85 m × 1,30 m × 0,65 m measured for sound absorption freely hanging in a reverberation chamber is found to have the following sound absorption area in the various octave bands:

Frequency, Hz	125	250	500	1 000	2 000	4 000
A_{obj}, m^2	8,5	9,9	11,0	11,9	11,8	11,4

All dimensions in millimetres

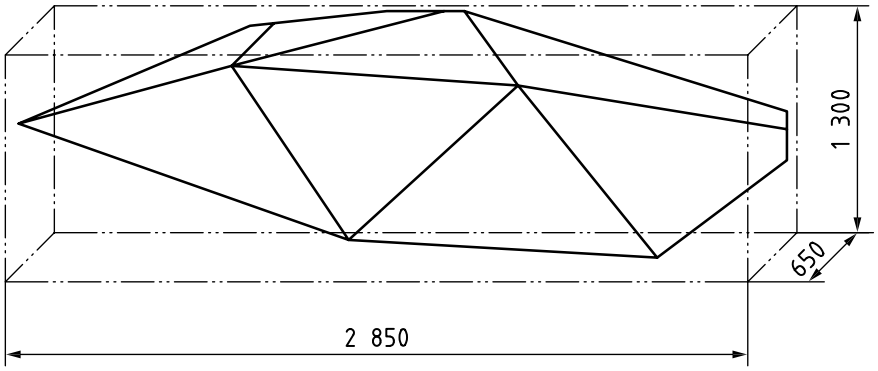


Figure B.4 — Example for a volume element

To evaluate α_{obj} the total exposed surface of the smallest cuboid, *S*, is then calculated according to the following:

$$S = 2\times2,85\times0,65+2\times1,30\times0,65+2\times1,3\times2,85 = 12,8\ m^2$$

The sound absorption coefficient for the object becomes:

Frequency, Hz	125	250	500	1 000	2 000	4 000
α_{obj}	0,65	0,75	0,85	0,95	0,90	0,90

B.6 Example for a desk

The area, *S,* of a desk is calculated according to the following formula:

$$S = 2\times1,60\times0,80+2\times1,60\times0,01+2\times0,80\times0,01 = 2,6\ m^2$$

All dimensions in millimetres

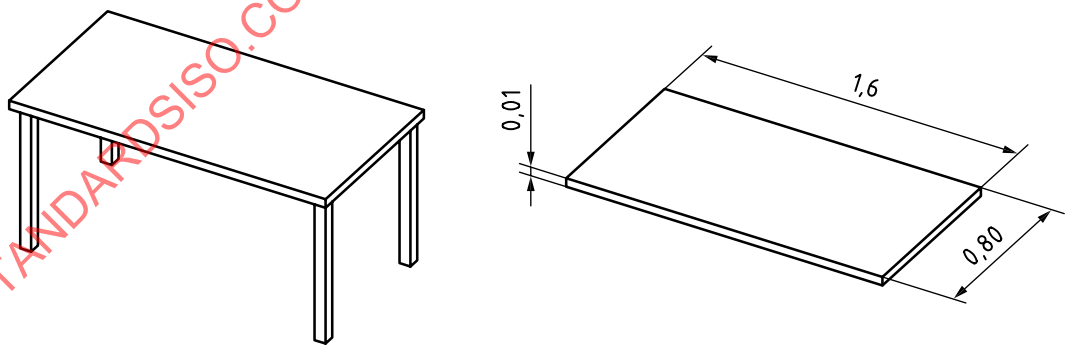


Figure B.5 — Example for a desk

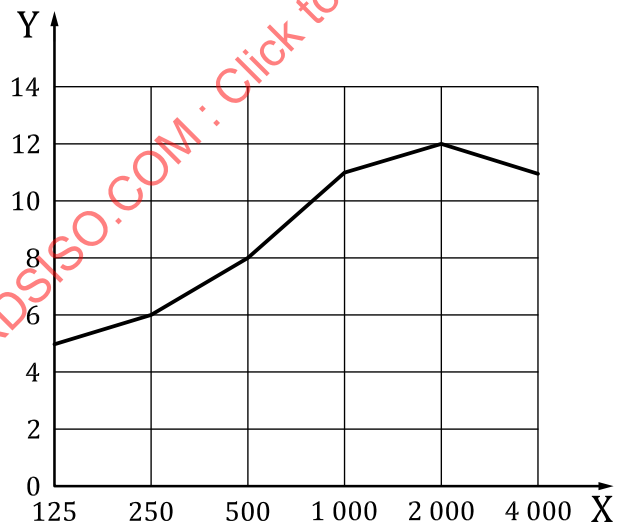
Annex C
(normative)

Presentation of floor screen sound attenuation

The screen sound attenuation shall be measured according to ISO 10053 and it shall be presented in the octave bands between 125 Hz and 4 000 Hz. Also, 63 Hz may be presented if desirable. Presentation is done in both the table and the diagram according to the example below. Values shall be rounded to the closest integer in decibel. The weighted screen sound attenuation, $\Delta L_{s,w}$, shall be evaluated and presented as described in ISO 10053.

Table C.1 — Example of presentation of screen sound attenuation

Frequency octave band Hz	**Screen sound attenuation, ΔL_s, according to ISO 10053** dB
63	Optional
125	5
250	6
500	8
1 000	11
2 000	12
4 000	11



Key

X frequency, in Hz

Y screen sound attenuation, ΔL_s, in dB

Figure C.1 — Example of presentation of screen sound attenuation

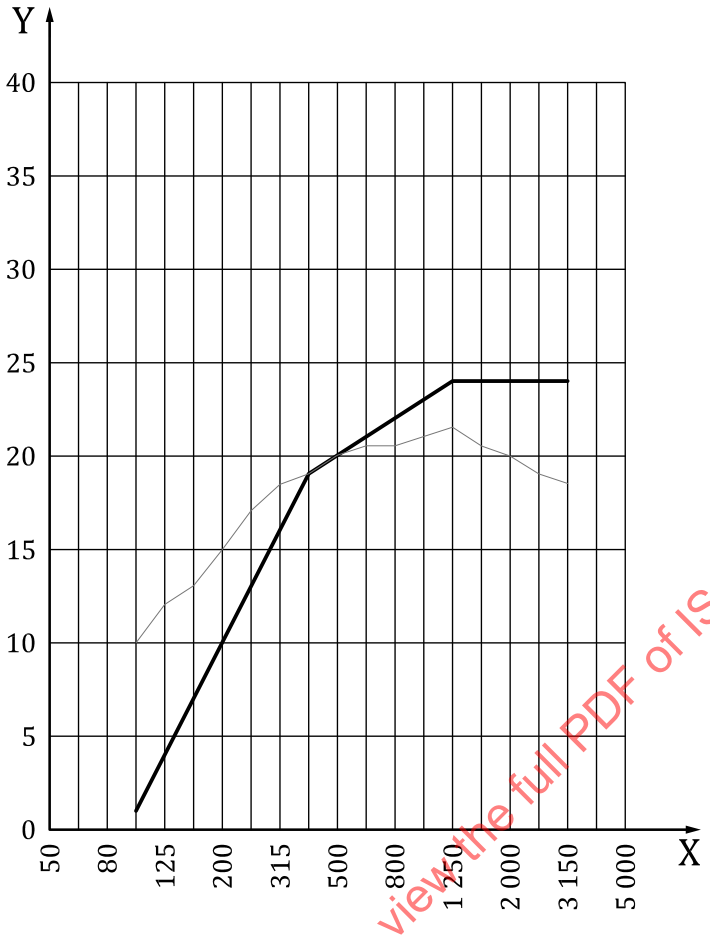
Annex D
(normative)

Presentation of screen sound insulation

Sound insulation of screens shall be presented using sound reduction indices in dB, given with one decimal, in 1/3 octave bands between 100 Hz and 5 000 Hz. The weighted value shall be given as an integer in accordance with the rules specified in ISO 717-1:2003, 5.2. Appropriate spectrum adaptation terms, defined in ISO 717-1, may be added. Results from 1/3 octave bands 50 Hz to 80 Hz are optional. Sound reduction indices shall be given both in the table and the diagram form, according to the example below. Also, the weighted sound reduction index, R_w, shall be given.

Table D.1 — Example of sound reduction values for sound insulation

1/3 octave band Hz	**Sound reduction index,** R dB
50	Optional
63	Optional
80	Optional
100	10,0
125	12,0
160	13,1
200	15,1
250	17,0
315	18,5
400	19,0
500	20,1
630	2,05
800	20,5
1 000	21,2
1 250	21,5
1 600	20,5
2 000	20,2
2 500	19,1
3 150	18,5
4 000	Optional
5 000	Optional
R_w	20



Key

X frequency, in Hz

Y sound reduction index, *R*, in dB

Figure D.1 — Example of presentation of sound reduction index for sound insulation

Annex E
(normative)

Mounting conditions in the laboratory

E.1 Single objects

E.1.1 Desk screens, type I mounting

The screens shall be mounted in the orientation of their intended use, i.e. desk screens shall stand vertically and shall rest on the edge that is aimed to be the bottom/horizontal edge. The screens may be mounted using temporary fixtures, provided that the fixtures do not cover a significant part of the screen's area. The number of screens shall be chosen to give as high equivalent sound absorption area as possible, but not exceeding 12 m^2 in any frequency band. The screens included in the test specimen shall be identical and of the same size.

No part of any screen may be closer than 1,0 m to any room boundary (except the floor) and individual identical screens shall be spaced at least 2,0 m apart. This limits the number of screens that can be used in the test specimen. However, the equivalent sound absorption area shall always exceed 1,0 m^2 in each frequency band.

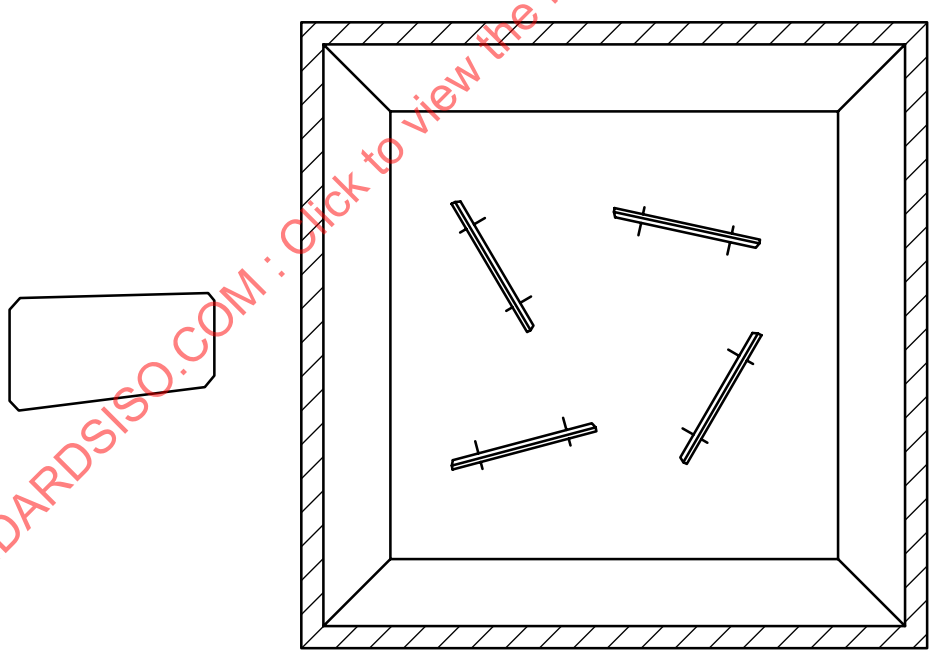


Figure E.1 — Desk screens, type I mounting

The sufficient number of screen sizes to be measured in order to evaluate an entire product series can be evaluated as follows:

A desk screen series is assumed to have one height – the screen sizes only vary in length. The smallest and largest sizes (lengths) are measured. In between, every third size is measured. The sizes that are not measured are evaluated using linear interpolation of the equivalent sound absorption area in each 1/3-octave band based on the measured equivalent sound absorption area of the nearest measured smaller and larger screen size.

The displayed equivalent sound absorption area from sizes that are not measured but calculated shall be indicated as “modelled based on the measured sizes according to ISO 20189:2018, E.1.1”.

EXAMPLE If the product series comprises seven different sizes, it is sufficient to measure three sizes. The smallest size, the largest and the median size in between. The measurement sequence becomes, from smallest size to largest: size 1 (measured), *then omit two sizes*, size 4 (measured), *then omit two sizes*, size 7 (measured). Sizes 2, 3, 5 and 6 are evaluated using linear interpolation, sizes 2 and 3 from the measurement results of size 1 and size 4, and sizes 5 and 6 from the measurement results of size 4 and size 7.

E.1.2 Floor screens, type II mounting

The screens shall be mounted in the orientation of their intended use, i.e. floor screens shall stand vertically and shall rest on the edge that is aimed to be the bottom/horizontal edge. The screens may be mounted using temporary fixtures, provided that the fixtures do not cover a significant part of the screen's area. The number of screens shall be chosen to give as high equivalent sound absorption area as possible, but not exceeding 12 m^2 in any octave band. The screens included in the test specimen shall be identical and of the same size.

No part of any screen may be closer than 1,0 m to any room boundary (except the floor) and individual identical screens shall be spaced at least 2,0 m apart. This limits the number of screens that can be used in the test specimen. The equivalent sound absorption area shall however always exceed 1,0 m^2 in each frequency band.

If the same product series comprises several sizes, a sufficient number of sizes shall be tested. The sizes to be tested can be determined using the same type of procedure as for desk screens for each floor screen height separately. This means that the smallest and largest sizes shall be measured, together with every third size in between (see E.1.1).

Different screen heights may be included in one measurement series (where each result is obtained from a measurement of a sample of identical sized screens) if it can be shown that the screen area does not differ more than 25 % between all adjacent sizes. The measurement series shall be split where the area difference is larger than 25 % between any two adjacent sizes. Each part then forms a new measurement series, and shall follow the requirements for one measurement series as specified in E.1.1.

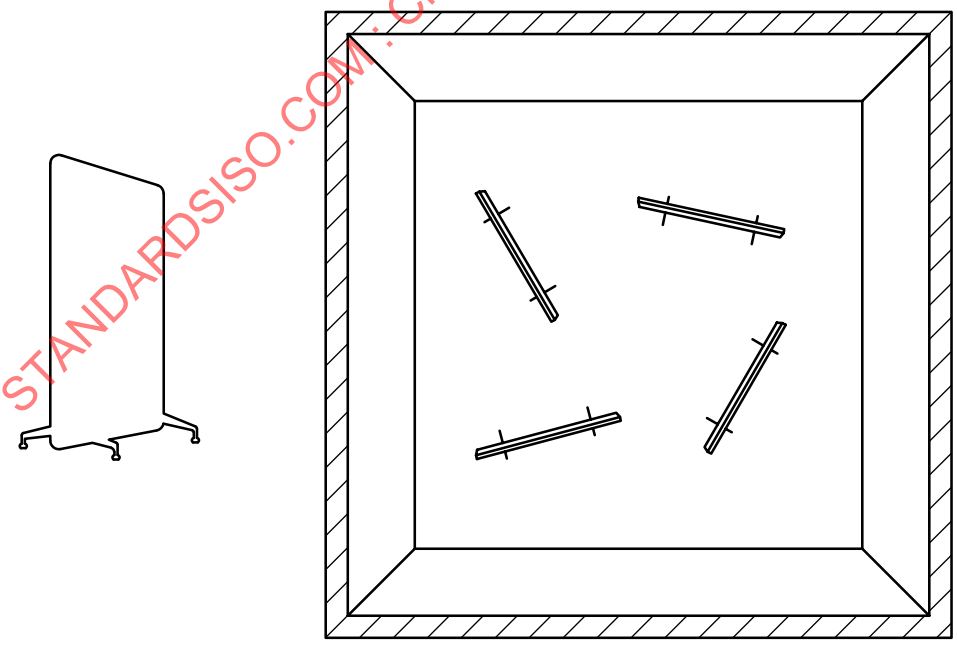


Figure E.2 — Floor screens, type II mounting

The displayed equivalent sound absorption area from sizes that are not measured but calculated shall be indicated as “modelled based on the measured sizes according to ISO 20189:2018, E.1.2”.

E.1.3 Furniture ensembles, type III mounting

A furniture ensemble is mounted directly standing on the reverberation room's floor, with 30° to 60° angle between a chosen major axis of the furniture ensemble and the surrounding walls (see Figure E.3). The measurements are performed without the chair. The number of furniture ensembles shall be chosen to give as high equivalent sound absorption area as possible, but not exceeding 12 m^2 in any frequency band. The equivalent sound absorption area shall however always exceed 1,0 m^2 in each frequency band. If the equivalent sound absorption area of the ensemble is expected to exceed 12 m^2 (comprising two big connected sofas for example), the ensemble units shall be measured separately.

No part of the furniture ensemble may be closer than 1,0 m to any room boundary (except the floor). Following ISO 354, the ensemble shall be measured in three separate positions. The distance between the respective positions' centre points should be larger than 2,0 m.

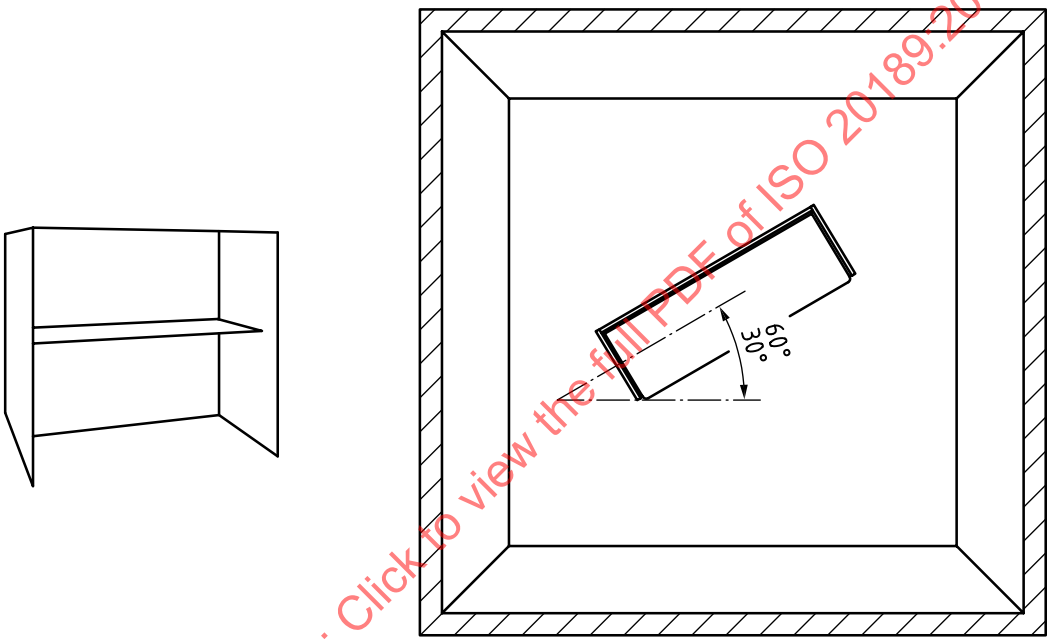


Figure E.3 — Furniture ensembles, type III mounting

E.1.4 Single sound absorbers aimed for walls, type IV mounting

Single sound absorbers intended for walls are mounted in the reverberation room as for their intended use, distributed as indicated in Figure E.4. They can be tested lying on the floor with a distance from the floor corresponding to the manufacturers mounting system. The number of objects shall be chosen to give as high equivalent sound absorption area as possible, but not exceeding 12 m^2 in any octave band. The sound absorbers included in the test specimen shall be identical and of the same size.

No part of any object may be closer than 1,0 m to any room boundary (except the floor) and individual identical sound absorbers shall be spaced at least 2,0 m apart. This limits the number of objects that can be used in the test specimen. The equivalent sound absorption area shall however always exceed 1,0 m^2 in each frequency band.

If the same product series comprises several sizes, a sufficient number of sizes shall be measured. The sizes to be tested to evaluate the sound absorption for the entire series can be determined using the same procedure as is described for floor screens.

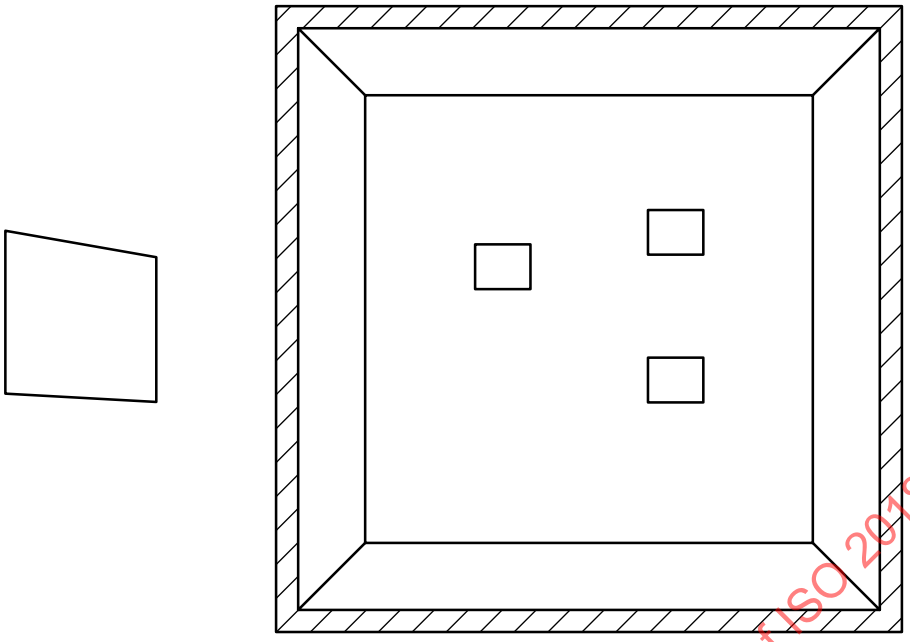


Figure E.4 — Single sound absorbers aimed for walls, type IV mounting

The displayed equivalent sound absorption area from sizes in a series of single sound absorbers intended for walls that are not measured but calculated shall be indicated as "modelled based on the measured sizes according to ISO 20189:2018, E.1.4".

E.1.5 Hanging flat elements, type V mounting

Hanging flat elements are mounted according to their intended use in the reverberation room, distributed as indicated in Figure E.5. They are tested hanging according to their actual mounting system. The number of objects shall be chosen to give as high equivalent sound absorption area as possible, but not exceeding 12 m^2 in any octave band. The elements included in the test specimen shall be identical and of the same size.

No part of any object may be closer than 1,0 m to any other object (for boundaries, see each mounting type). This limits the number of objects that can be used in the test specimen. The equivalent sound absorption area shall however always exceed 1,0 m^2 in each frequency band.

If the same product series comprises several sizes, a sufficient number of sizes shall be measured. The sizes to be tested to evaluate the sound absorption for the entire series can be determined using the same procedure as described for floor screens.

Type V.1: Mounting conditions at a certain specified short distance from a wall, i.e. resembling a type G-100 mounting. The specimen should not be mounted closer than 1,0 m to any boundary except the backing wall. Type V.1 is not used as a basis to calculate α_{obj} according to Annex B.

Type V.2: Mounting conditions in the middle of a room ("visual room divider"). The specimen should be mounted freely hanging in the reverberation room, not closer than 1,0 m to any boundary. The specimen shall not hang in parallel to any wall: an angle of at least 10° is required. Note that this mounting exposes both sides of a sample to the sound field, which reduces the number of objects in the test specimen in order not to exceed an equivalent sound absorption area of 12 m^2. The object may be mounted closer according to manufacturer specifications in specific cases. Type V.2 is used as a basis to calculate α_{obj} according to Annex B.

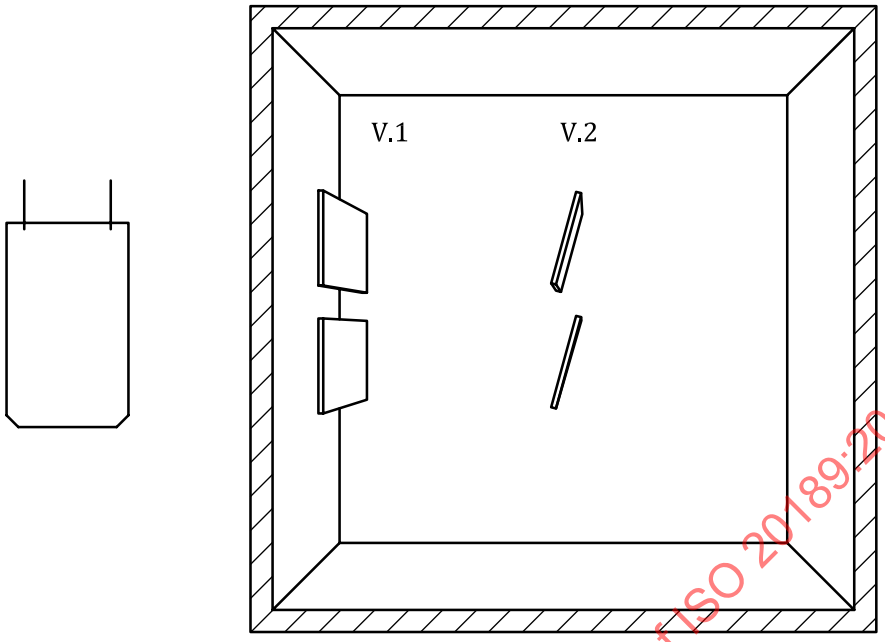


Figure E.5 — Hanging flat elements, type V mounting

E.1.6 Volume elements, type VI mounting

Volume elements are comprised of "clouds" or an array of "clouds". They can also comprise free-floating objects, inflatable absorbers, hanging or standing lamps or any other object aimed for freely suspended mounting or standing on any support on the floor. The number of objects shall be chosen to give as high equivalent sound absorption area as possible, but not exceeding 12 m^2 in any frequency band.

No part of any object may be closer than 1,0 m to any room boundary (except the floor) or any other object. This limits the number of objects that can be used in the test specimen. The equivalent sound absorption area shall however always exceed 1,0 m^2 in each frequency band.

Type VI.1: Mounting conditions hanging freely in the reverberation room according to their intended use, as indicated in Figure E.6. If the same product series comprises several sizes, a sufficient number of sizes shall be tested. The sizes to be tested to evaluate the sound absorption for the entire series can be determined using the same procedure as described for floor screens.

Type VI.2: Mounting conditions standing freely on any support in the reverberation room according to their intended use, as indicated in Figure E.6. If the same product series comprises several sizes, a sufficient number of sizes shall be tested. The sizes to be tested to evaluate the sound absorption for the entire series can be determined using the same procedure as described for floor screens.

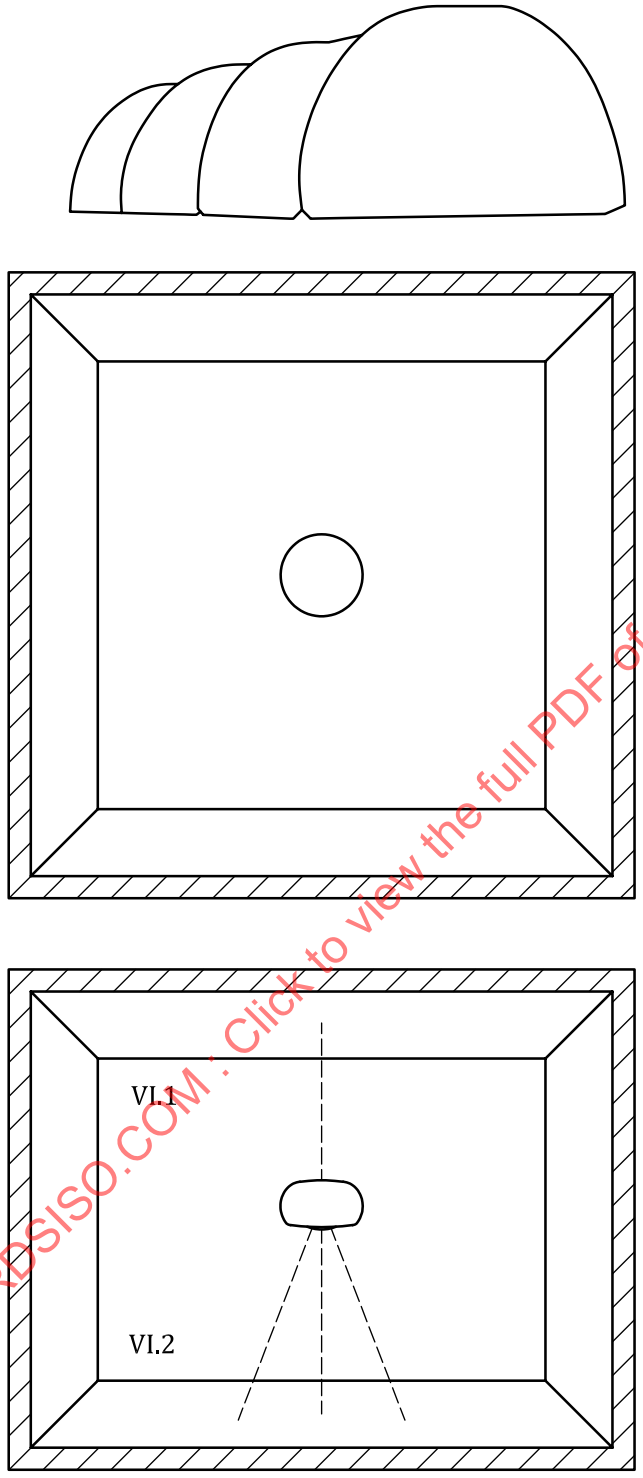


Figure E.6 — Volume elements, type VI mounting

E.1.7 Sofas, type VII mounting

Sofas are always tested standing in the middle of the reverberation chamber. A sofa can also be tested standing close to a wall, to simulate that condition in reality (optional). Normally, one sofa is sufficient during the test, and the requirements for furniture ensembles (Type III mounting) shall be followed.

Type VII.1: Intended to be mounted free standing in a room.

Type VII.2: Intended to be mounted standing in front of a wall (optional).