INTERNATIONAL STANDARD

ISO 16535

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Thermal insulating products for building applications — Determination of long-term water absorption by immersion

Produits isolants thermiques destinés aux applications du bâtiment — Détermination de l'absorption d'eau à long terme par immersion

Reference number
ISO 16535:2012(E)

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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.

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 16535 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

ISO 16535 includes the original EN 12087 prepared by Technical Committee CEN/TC 88 “Thermal insulating materials and products”, with the following clauses modified to reflect the conditions for tropical countries:

— Clause 5.4: Conditioning of test specimens;

— Clause 6.1: Test conditions;

— Clause 9: Test report.

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Introduction

ISO 16535 is one of a series of existing European Standards on test methods which were adopted by ISO. This group of International Standards comprises the following group of interrelated standards:

ISO	Title	Respective EN standard
12344	Thermal insulating products for building applications — Determination of bending behaviour	EN 12089
12968	Thermal insulation products for building applications — Determination of the pull-off resistance of external thermal insulation composite systems (ETICS) (foam block test)	EN 13495
29465	Thermal insulating products for building applications — Determination of length and width	EN 822
29466	Thermal insulating products for building applications — Determination of thickness	EN 823
29467	Thermal insulating products for building applications — Determination of squareness	EN 824
29468	Thermal insulating products for building applications — Determination of flatness	EN 825
29469	Thermal insulating products for building applications — Determination of compression behaviour	EN 826
29470	Thermal insulating products for building applications — Determination of the apparent density	EN 1602
29471	Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 degrees C/50 % relative humidity)	EN 1603
29472	Thermal insulating products for building applications — Determination of dimensional stability under specified temperature and humidity conditions	EN 1604
29764	Thermal insulating products for building applications — Determination of deformation under specified compressive load and temperature conditions	EN 1605
29765	Thermal insulating products for building applications — Determination of tensile strength perpendicular to faces	EN 1607
29766	Thermal insulating products for building applications — Determination of tensile strength parallel to faces	EN 1608
29767	Thermal insulating products for building applications — Determination of short-term water absorption by partial immersion	EN 1609
29768	Thermal insulating products for building applications — Determination of linear dimensions of test specimens	EN 12085
29769	Thermal insulating products for building applications — Determination of behaviour under point load	EN 12430
29770	Thermal insulating products for building applications — Determination of thickness for floating-floor insulating products	EN 12431
29771	Thermal insulating materials for building applications — Determination of organic content	EN 13820

29803	Thermal insulation products for building applications — Determination of the resistance to impact of external thermal insulation composite systems (ETICS)	EN 13497
29804	Thermal insulation products for building applications — Determination of the tensile bond strength of the adhesive and of the base coat to the thermal insulation material	EN 13494
29805	Thermal insulation products for building applications — Determination of the mechanical properties of glass fibre meshes	EN 13496
16534	Thermal insulating products for building applications — Determination of compressive creep	EN 1606
16535	Thermal insulating products for building applications — Determination of long-term water absorption by immersion	EN 12087
16536	Thermal insulating products for building applications — Determination of long-term water absorption by diffusion	EN 12088
16537	Thermal insulating products for building applications — Determination of shear behaviour	EN 12090
16546	Thermal insulating products for building applications — Determination of freeze-thaw resistance	EN 12091
16544	Thermal insulating products for building applications — Conditioning to moisture equilibrium under specified temperature and humidity conditions	EN 12429
16545	Thermal insulating products for building applications — Determination of behaviour under cyclic loading	EN 13793

A further group of existing European Standards on test methods for products used to insulate building equipment and industrial installations comprises the following group of interrelated International Standards:

ISO 12623	Thermal insulating products for building equipment and industrial installations — Determination of short-term water absorption by partial immersion of preformed pipe insulation	EN 13472
ISO 12624	Thermal insulating products for building equipment and industrial installations — Determination of trace quantities of water soluble chloride, fluoride, silicate, sodium ions and pH	EN 13468
ISO 12628	Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation	EN 13467
ISO 12629	Thermal insulating products for building equipment and industrial installations — Determination of water vapour transmission properties of preformed pipe insulation	EN 13469

Thermal insulating products for building applications — Determination of long-term water absorption by immersion

1 Scope

This International Standard specifies the equipment and procedures for determining the long-term water absorption of test specimens. It is applicable to thermal insulating products.

This International Standard specifies two options:

— Method 1: partial immersion; and

— Method 2: total immersion.

The long-term water absorption by partial immersion is intended to simulate the water absorption caused by long-term water exposure.

The long-term water absorption by total immersion is not directly related to the conditions on site, but has been recognized as a relevant condition of test for some products in some applications.

2 Normative references

The following referenced document is indispensable for the application 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 29768, *Thermal insulating products for building applications — Determination of linear dimensions of test specimens*

3 Principle

3.1 Partial immersion (Method 1). The long-term water absorption by partial immersion is determined by measuring the change in mass of a test specimen, the lower part of which is in contact with water for a period of 28 days.

The excess water adhering to the surface, not absorbed by the test specimen, is removed by drainage in Method 1A or taken into account by deduction of the initial water uptake in Method 1B.

3.2 Total immersion (Method 2). The long-term water absorption by total immersion is determined by measuring the change in mass of the test specimen, totally immersed in water, over a period of 28 days.

The excess water adhering to the surface, not absorbed by the test specimen, is removed by drainage in Method 2A or taken into account by deduction of the initial water uptake in Method 2B.

4 Apparatus

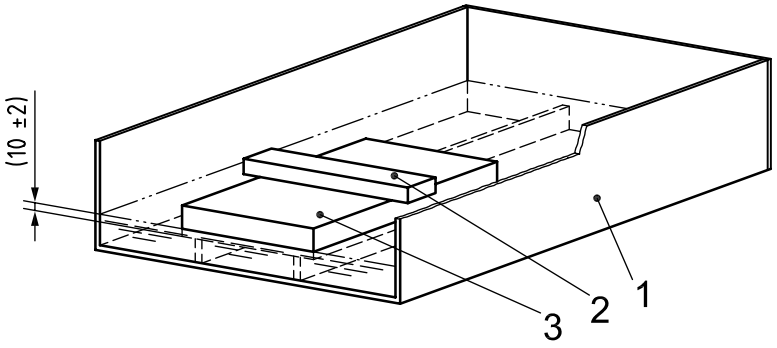
4.1 Balance, allows the determination of the mass of a test specimen to 0,1 g.

4.2 Water tank, with a device for keeping the water level constant to within $\pm$ 2 mm, and a device to keep the test specimen in the required position. Examples of test devices are given in Figures 1, 2 and 3. The device to keep the test specimen in position shall not cover more than 15 % of the cross-sectional area of the test specimen, which is exposed to water. The device shall be such that the original form of the test specimen is maintained.

4.3 **Tap water**, adjusted to a temperature of (23 ± 5) °C.

4.4 **Equipment for drainage.** The principle for Methods 1A and 2A is illustrated in Figures 4a) and 4b).

Dimensions in millimetres.

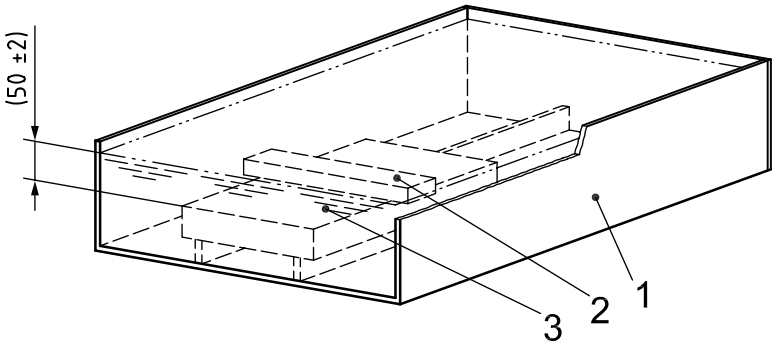


Key

1 water tank
2 load to keep the test specimen in position
3 test specimen

Figure 1 — Example of equipment for the determination of water absorption by partial immersion (Methods 1A and 1B)

Dimensions in millimetres.

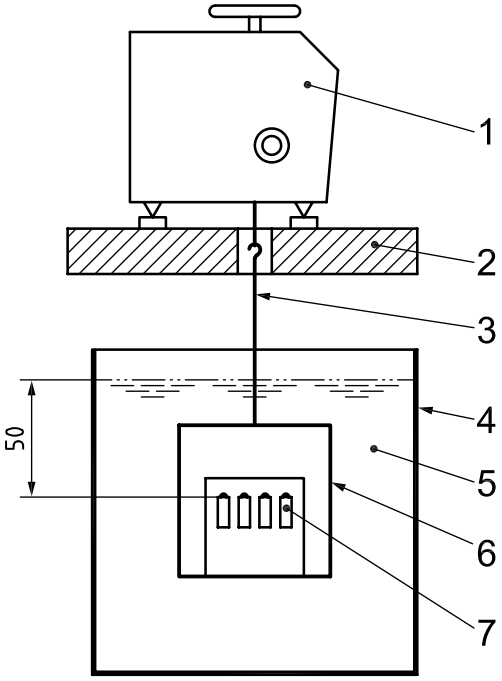


Key

1 water tank
2 load to keep the test specimen in position
3 test specimen

Figure 2 — Example of equipment for the determination of water absorption by total immersion (Methods 2A and 2B)

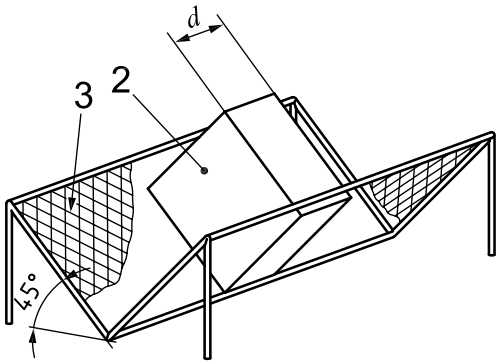
Dimensions in millimetres.



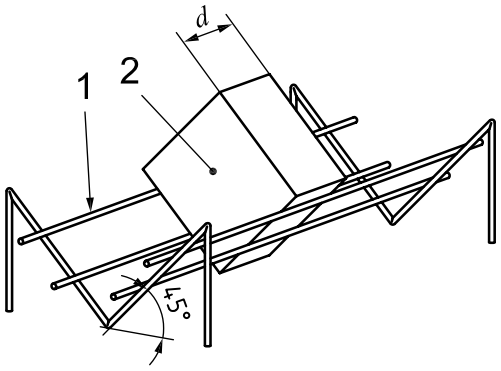
Key

1 balance
2 weighing table
3 linkage
4 water container
5 water
6 mesh cage made of stainless material with fixing rods or a sinker large enough in mass to compensate for the upthrust of the test specimen
7 test specimen

Figure 3 — Example of equipment for the determination of water absorption by total immersion (Method 2C)



a)



b)

Key

1 stainless steel mesh
2 test specimen
3 perforated stainless steel

Figure 4 — Examples of equipment for drainage

5 Test specimens

5.1 Dimensions of test specimens

The thickness of the test specimens shall be the original product thickness.

The test specimens shall be squares with squarely cut edges having sides of (200 ± 1) mm.

5.2 Number of test specimens

The number of test specimens shall be as specified in the relevant product standard or any other European technical specification. In the absence of such a specification, at least four test specimens shall be used.

NOTE In the absence of a product standard or any other technical specification, the number of test specimens can be agreed between parties.

5.3 Preparation of test specimens

The test specimens shall be cut so that they do not include original product edges.

Test specimens shall be prepared by methods that do not substantially change the original structure of the product. Any skins, facings and/or coatings shall be retained.

NOTE Special methods of preparation, when needed, are given in the relevant product standard or any other European technical specification.

5.4 Conditioning of test specimens

The test specimens shall be stored for at least 6 h at (23 ± 5) °C. In case of dispute, they shall be stored at (23 ± 2) °C and (50 ± 5) % relative humidity (RH) for the time stated in the relevant product standard with a minimum of 6 h.

In tropical countries, different conditioning and testing conditions are relevant. In this case, the conditions shall be (27 ± 5) °C and (65 ± 5) % RH, and be stated clearly in the test report.

6 Procedure

6.1 Test conditions

The test shall be carried out at (23 ± 5) °C. In case of dispute it shall be carried out at (23 ± 2) °C.

In tropical countries, different conditioning and testing conditions can be relevant. In this case, the conditions shall be (27 ± 2) °C and (65 ± 5) % RH.

6.2 Test procedure

The method shall be as specified in the relevant product standard or any other European technical specification.

NOTE 1 In the absence of such a specification the method can be agreed between parties.

The long-term water absorption is determined after 28 days immersion.

NOTE 2 If requested, readings can be made at shorter time periods, e.g. after 7 day and 14 day immersion periods.

The dimensions of the test specimens shall be measured in accordance with ISO 29768 to the nearest 0,5 mm before the test.

If any dimensional changes are noticed after the immersion period, the dimensions of the test specimens should be measured again.

6.2.1 Long-term water absorption by partial immersion (Method 1)

6.2.1.1 Method 1A (drainage)

Weigh the test specimen to the nearest 0,1 g to determine its initial mass, m_0.

The test is made with half of the test specimens with one major face upwards. The other half are tested with the same major face downwards.

Place the test specimen in the empty water tank and apply a sufficient load to keep it partially immersed when water is added. Carefully add the water to the tank until the bottom face of the test specimen is (10 ± 2) mm below the surface of the water (see example in Figure 1). Ensure that the water level remains constant during the test.

After 28 days, remove the test specimen; drain it for (10 ± 0,5) min by placing it vertically on a mesh, inclined at 45 °, as shown in Figure 4a) and 4b). Weigh the test specimen again to determine its mass, m_{28}.

6.2.1.2 Method 1B (deduction of initial water uptake)

Weigh the test specimen to the nearest 0,1 g to determine its initial mass, m_0.

The test is made with half of the test specimens with one major face upwards. The other half are tested with the same major face downwards.

Place the test specimen in the water tank in such a position that it is partially immersed in water with the bottom face of the test specimen (10 ± 2) mm below the water level. Remove the test specimen after 10 s, holding it horizontally and place it, within 5 s, in a plastic tray of known mass. Reweigh this tray with the test specimen to determine the mass, m_1, of the test specimen including the initial water uptake.

Replace the test specimen in the water tank and apply a sufficient load to keep it partially immersed in water with the bottom face of the test specimen (10 ± 2) mm below the water level (see example in Figure 1). Ensure that the water level remains constant during the test.

The test is made with half of the test specimens with one major face upwards and with the other half with the same major face downwards.

After 28 days, remove the test specimen holding it horizontally and place it, within 5 s, in the plastic tray of previously determined mass to determine its mass, m_{28}.

Method 1B is only applicable if the initial water uptake is less than or equal to 0,5 kg/m^2, where this is calculated using the expression:

$$\frac{m_1 - m_0}{A_p}$$

where

m_0 is the initial mass of the test specimen as determined in Method 1B, in kg;

m_1 is the mass of the test specimen including the initial water uptake in Method 1B, in kg;

A_p is the bottom surface area of the test specimen, in m^2.

6.2.2 Long-term water absorption by total immersion (Method 2)

6.2.2.1 Method 2A (drainage)

Weigh the test specimen to the nearest 0,1 g to determine its initial mass, m_0.

Place the test specimen in the empty water tank and apply a sufficient load to keep the test specimen totally immersed in water. Carefully add water to the tank until the top face of the test specimen is (50 ± 2) mm below the surface of the water (see Figure 2). Ensure that the water level remains constant during the test.

After 28 days, remove the test specimen; drain it for (10 ± 0,5) min by placing it vertically on a mesh, inclined at 45 °, as shown in Figure 4a) and 4b). Then weigh the test specimen again to determine its mass, m_{28}.

6.2.2.2 Method 2B (deduction of initial water uptake)

Weigh the test specimen to the nearest 0,1 g to determine its initial mass, m_0.

Place the test specimen in the water tank in such a position that it is totally immersed in water with the top face of the test specimen (50 ± 2) mm below the water level. Remove the test specimen after 10 s, holding it horizontally and place it, within 5 s, in a plastic tray of known mass. Reweigh this tray with the test specimen to determine the mass of the test specimen, m_1, including the initial water uptake.

Replace the test specimen in the water tank and apply a sufficient load to keep the test specimen totally immersed in water, with the top face of the test specimen (50 ± 2) mm below the water level (see example in Figure 2). Ensure that the water level remains constant during the test.

After 28 days remove the test specimen, holding it horizontally, and place it within 5 s in the plastic tray of previously determined mass to determine its mass, m_{28}.

Method 2B is only applicable if the initial water uptake is less than or equal to 0,5 kg/m^2, where this is calculated using the expression:

$$\frac{m_1 - m_0}{A_t}$$

where

m_0 is the initial mass of the test specimen as determined in method 2B, in kg;

m_1 is the mass of the test specimen including the initial water uptake in method 2B, in kg;

A_t is the total surface area of the test specimen exposed to water, in m^2.

6.2.2.3 Method 2C

Weigh the test specimen to the nearest 0,1 g to determine its initial mass, m_0.

Determine the linear dimensions of the test specimen (l_0, b_0, d_0) according to ISO 29768 to the nearest 0,5 mm. Fill the water container with the tap water. Weigh the immersed empty cage to the nearest 0,1 g (mass m_1).

Remove the cage and attach the test specimen horizontally in the cage so that the distance between the surface of the water and the top surface of the test specimen is (50 ± 2) mm. Ensure that this distance remains constant during the test. Immerse the assembled cage, and attach it to the balance.

Remove obvious air bubbles from the test specimen with a brush or by agitation.

Ensure that the cage remains at the same level relative to the surface of the water for all weighings.

After 28 days, determine the apparent mass, m_{28}, of the submerged cage containing the test specimen, to the nearest 0,1 g.

Remeasure the linear dimensions of the test specimen as before (l_1, b_1, d_1) to the nearest 0,5 mm.

7 Calculation and expression of results

7.1 General

The test result shall be the mean value of the individual values. For products having different faces (facings) on each side, two mean values are calculated in Method 1.

Results shall not be extrapolated to other thicknesses.

Results obtained by different water absorption test methods are not comparable.

7.2 Long-term water absorption by partial immersion

Calculate the long-term water absorption by partial immersion for each test specimen, W_{lp}, in kg/m^2 using Equation (1) or (2):

Method 1A

$$W_{lp} = \frac{m_{28} - m_0}{A_p} \quad (1)$$

Method 1B

$$W_{lp} = \frac{m_{28} - m_1}{A_p} \quad (2)$$

where

m_0 is the initial mass of the test specimen as determined in Method 1A, in kg;

m_1 is the mass of the test specimen, including the initial water uptake in Method 1B, in kg;

m_{28} is the mass of the test specimen after partial immersion for 28 days (Methods 1A and 1B), in kg;

A_p is the bottom surface area of the test specimen, in m^2.

W_{lp} shall be rounded to the nearest 0,01 kg/m^2.

7.3 Long-term water absorption by total immersion

Calculate the long-term water absorption by total immersion, W_{lt}, in volume percent using Equation (3) or (4):

Method 2A

$$W_{\mathrm{lt}} = \frac{m_{28} - m_0}{V} \times \frac{100}{\rho_{\mathrm{W}}} \tag{3}$$

Method 2B

$$W_{\mathrm{lt}} = \frac{m_{28} - m_1}{V} \times \frac{100}{\rho_{\mathrm{W}}} \tag{4}$$

where

m_0 is the initial mass of the test specimen as determined in Method 2A, in kg;

m_1 is the mass of the test specimen including the initial water uptake in Method 2B, in kg;

m_{28} is the mass of the test specimen after total immersion for 28 days in Methods 2A and 2B, in kg;

V is the initial volume of the test specimen, in m^3;

ρ_{W} is the density of water, assumed to be 1000 kg/m^3.

W_{lt} shall be rounded to the nearest 0,1 volume percent.

Method 2C

Calculate the water absorption after the immersion time of 28 days, W_{28}, in percent volume using Equation (5):

$$W_{28} = \frac{m_{28} + V_1 \times \rho_{\mathrm{W}} - m_0 - m_1}{V0 \times \rho_{\mathrm{W}}} \times 100 \tag{5}$$

where

m_0 is the initial mass of the test specimen, in kg;

m_1 is the mass of the empty cage immersed, in kg;

m_{28} is the mass of the test specimen and the cage submerged after 28 days of immersion, in kg;

$V_0 = l_0 \times b_0 \times d_0$ is the initial volume of the test specimen, in m^3;

$V_1 = l_1 \times b_1 \times d_1$ is the volume of the test specimen after 28 days of immersion, in m^3;

ρ_{W} is the density of water, assumed to be 1000 kg/m^3.

W_{28} shall be rounded to the nearest 0,1 volume percent.

8 Accuracy of measurement

NOTE It has not been possible to include a statement on the accuracy of measurement in this edition of this International Standard, but it is intended to include such a statement when this International Standard is next revised.

9 Test report

The test report shall include the following information:

a) Reference to this International Standard, i.e. ISO 16535:2012;

b) Product identification

1) product name, factory, manufacturer or supplier;

2) production code number;

3) type of product;

4) packaging;

5) the form in which the product arrived at the laboratory;

6) other information as appropriate, e.g. nominal dimensions, nominal density.

c) Test procedure

1) pre-test history and sampling, e.g. who sampled and where;

2) conditioning;

3) dimensions of the test specimens;

4) if any deviation from Clauses 6 and 7;

5) date of testing;

6) conditioning and testing conditions in tropical countries, if applicable;

7) general information related to the test including reference to methods used (1A, 2A, 1B, 2B or 2C) and, if relevant, the initial water uptake;

8) events which may have affected the results.

Information about the apparatus and identity of the technician should be available in the laboratory, but it need not be recorded in the report.

d) Results [all individual values and the mean value (s)].

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