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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

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Foreword

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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).

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This document was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 88, *Thermal insulating materials and products*, in collaboration with ISO Technical Committee TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16535:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

— The content in 5.3, 6.4, 7.1 and 10 has been revised to reflect the conditions for tropical countries.

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.

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

1 Scope

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

This document specifies two methods:

— Method 1: Partial immersion;

— 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 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 29768, *Thermal insulating products for building applications — Determination of linear dimensions of test specimens*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Principle

4.1 Method 1: Partial immersion

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.

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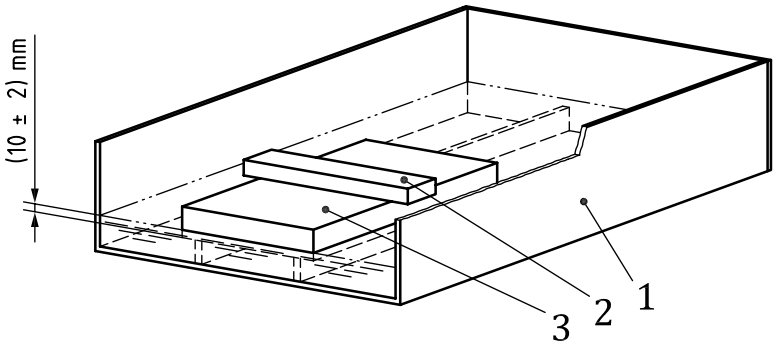


Key

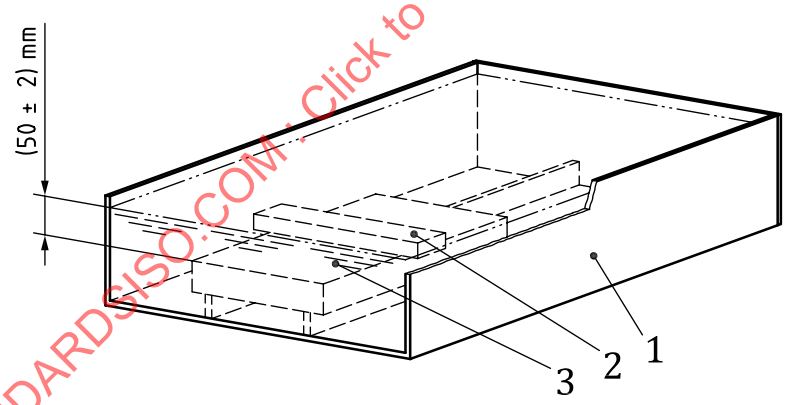
1 water tank
2 load to keep the test specimen in position
3 test specimen

Figure 1 — Example of partial immersion test device (method 1A and 1B)

4.2 Method 2: Total immersion

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. The method 2C use the Archimedes' principle to allow a determination of water absorption without moving the sample from the water tank.



Key

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

Figure 2 — Example of test device for the determination of water absorption by total immersion (method 2A and 2B)

5 Apparatus

5.1 Balance, capable of determining the mass of a test specimen with an accuracy of 0,1 g.

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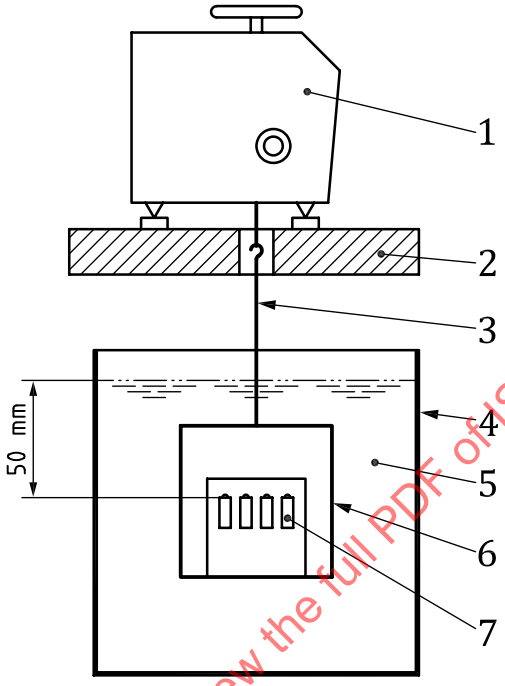
5.2 Water tank, with a device for keeping the water level constant to within ±2 mm, and a device to keep the test specimen in the required position.

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-section 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.



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 test device for determination of water absorption by total immersion (method 2C)

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5.3 Tap water, adjusted to a temperature of (23 ± 5) °C. In case of dispute, deionised water shall be used.

In tropical countries, different conditions and testing conditions can be relevant. In such cases the temperature shall be (27 ± 5) °C, and this shall be stated in the test report.

5.4 Equipment for drainage.

Examples are shown in Figures 4 a) and 4 b).

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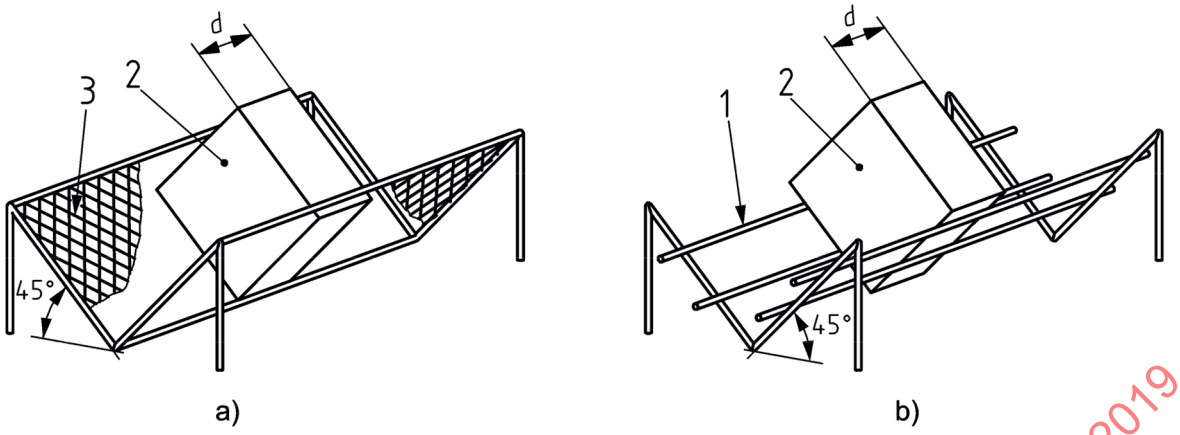

Key

1 stainless steel mesh
2 test specimen
3 perforated stainless steel
d thickness of the sample

Figure 4 — Examples of equipment for drainage

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6 Test specimens

6.1 Dimensions of test specimens

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

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

6.2 Number of test specimens

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

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

6.3 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.

Special methods of preparation, when needed, are given in the relevant product standard or any other technical specification for thermal insulation products

6.4 Conditioning of test specimens

The test specimens shall be conditioned 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 for the time stated in the relevant product standard with a minimum of 6 h.

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In tropical countries, different conditioning can be relevant. In this case, the conditions shall be (27 ± 5) °C (65 ± 5) RH (relative humidity), for at least 6 h and be stated clearly in the test report.

7 Procedure

7.1 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 testing conditions can be relevant. In this case, the conditions shall be (27 ± 2) °C (65 ± 5) % RH (relative humidity) and be stated clearly in the test report.

7.2 Test procedure

The method shall be as specified in the relevant product standard or any other technical specification for thermal insulation products.

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.

If requested, readings can be made at shorter time periods, e.g. after 7- 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.

7.2.1 Long-term water absorption by partial immersion (method 1)

Method 1A (drainage)

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

The test is carried out with half of the test specimens with one major face upwards and with the other half 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 4 a) or 4 b). Weigh the test specimen again to determine its mass, m_{28}.

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 and with the other half with the same major face downwards.

Place the test specimen in the water tank in such 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.

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Replace the test specimen in the water tank and apply a sufficient load to keep the test specimen 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.

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 kilograms;

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

A_p is the bottom surface area of the test specimen, in square metres.

7.2.2 Long-term water absorption by total immersion (method 2)

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 4 a) or 4 b). Then weigh the test specimen again to determine its mass, m_{28}.

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 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:

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

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where

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

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

A_t is the total surface area of the test specimen exposed to water, in square metres.

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 will be (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.

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

8 Calculation and expression of results

8.1 General

The test result shall be the mean value of the individual values (for products having dissimilar faces two mean values shall be calculated in method 1).

Results shall not be extrapolated to other thicknesses.

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

8.2 Long-term water absorption by partial immersion

Calculate the long-term water absorption by partial immersion for each test specimen, W_{lp}, in kilograms per square metre using Formula (1) or Formula (2).

Method 1A:

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

Method 1B:

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

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where

m_0 is the initial mass of the test specimen as determined in method 1A, in kilograms;

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

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

A_p is the bottom surface area of the test specimen, in square metres;

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

8.3 Long-term water absorption by total immersion

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

Method 2A:

$$W_{lt} = \frac{m_{28} - m_0}{V_0} \times \frac{100}{\rho_w} \quad (3)$$

Method 2B:

$$W_{lt} = \frac{m_{28} - m_1}{V_0} \times \frac{100}{\rho_w} \quad (4)$$

where

m_0 is the initial mass of the test specimen as determined in method 2A, in kilograms;

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

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

V_0 is the initial volume of the test specimen, in cubic metres;

ρ_W is the density of water, assumed to be 1 000 kg/m^3;

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

Method 2C

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

$$W_{28} = \frac{m_{28} + V_1 \times \rho_w - m_0 - m_1}{V_0 \times \rho_w} \times 100 \quad (5)$$

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