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Hygrothermal performance of building materials and products — Determination of moisture adsorption/desorption properties in response to humidity variation

Performance hygrothermique des matériaux et produits pour le bâtiment — Détermination des propriétés d'adsorption/désorption de l'humidité en réponse à une fluctuation de l'humidité

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Foreword

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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 24353 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

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Introduction

This International Standard describes a test method that is applicable to materials used to inhibit fluctuation of indoor relative humidity. Testing of sorption/desorption efficiency permits the evaluation of materials for applications such as adjusting the relative humidity of museum storage and exhibition spaces.

Materials selected for their adsorption/desorption efficiency have recently come to be used in homes and medical care facilities in the interest of creating healthy and comfortable indoor environments.

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Hygrothermal performance of building materials and products — Determination of moisture adsorption/desorption properties in response to humidity variation

1 Scope

This International Standard specifies a test method for determining moisture adsorption/desorption properties of building materials in response to humidity variation. This International Standard also defines the adsorption/desorption efficiency of building materials, measured as the change in mass of a specimen moved from a given space to another one of different relative humidity and equal temperature.

Moisture adsorption/desorption properties of materials are measured under conditions of a single cycle and several cycles.

2 Normative references

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The following referenced documents are 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.

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ISO 12571:2000, *Hygrothermal performance of building materials and products — Determination of hygroscopic sorption properties*

ISO 12572:2001, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
moisture adsorption/desorption property
property of a material related to its capacity for and efficiency in moisture adsorption/desorption

3.1.2
moisture adsorption process
process by which moisture is adsorbed into a material from ambient air until equilibrium is reached

3.1.3
moisture desorption process
process by which moisture is desorbed from a material into ambient air until equilibrium is reached

3.1.4
moisture adsorption content
amount of moisture adsorbed into a specimen of a given material per unit of surface area of that material

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3.1.5
moisture desorption content
amount of moisture desorbed by a specimen of a given material per unit of surface area of that material

3.1.6
water vapour surface resistance
resistance against the transfer of water vapour across the boundary layer between the ambient air and the surface of a building component such as a wall

3.1.7
resistance of water vapour transmission
resistance against the transfer of water vapour through a building component, such as wall, from one surface in contact with the water vapour in the air to the other

3.1.8
moisture adsorption rate
rate of adsorbing moisture of the material from the ambient air

3.1.9
moisture desorption rate
rate of desorbing moisture of the material to the ambient air

3.2 Symbols and units

Symbol	Description	Unit
A	Surface area of adsorption/desorption	m^2
G_n	Adsorption/desorption rate at time n	$kg/(m^2 \cdot h)$
m_0	Mass of the specimen after preconditioning	kg
m_a	Mass of the specimen at the time of completion of moisture adsorption process	kg
m_{a4}	Mass of the specimen at the time of completion of moisture adsorption process of the 4th adsorption/desorption cycle	kg
m_d	Mass of the specimen at the time of completion of moisture desorption process	kg
m_{d3}	Mass of the specimen at the time of completion of moisture desorption process of the 3rd adsorption/desorption cycle	kg
m_{d4}	Mass of the specimen at the time of completion of moisture desorption process of the 4th adsorption/desorption cycle	kg
m_n	Mass of specimen at time n	kg
m_{n-1}	Mass of specimen at time n–1	kg
R_1	Resistance of water vapour on single-layered specimen	$m^2 \cdot h \cdot Pa/\mu g$
R_2	Resistance of water vapour on double-layered specimen	$m^2 \cdot h \cdot Pa/\mu g$
Δt	Elapsed time	h
$1/\beta$	Water vapour surface resistance of specimen	$m^2 \cdot h \cdot Pa/\mu g$
$\rho_{A,a}$	Change of moisture content at the time of completion of adsorption process	kg/m^2
$\rho_{A,ac}$	Moisture adsorption content at the time of completion of moisture adsorption process of the 4th sorption/desorption cycle	kg/m^2
$\rho_{A,d}$	Moisture desorption content at the time of completion of desorption process	kg/m^2
$\rho_{A,dc}$	Moisture desorption content at the time of completion of moisture desorption process of the 4th adsorption/desorption cycle	kg/m^2
$\rho_{A,s}$	Difference between moisture adsorption/desorption content at the time of completion of the test	kg/m^2
$\rho_{A,sc}$	Difference between moisture adsorption/desorption content at the time of completion of the 4th adsorption/desorption cycle	kg/m^2

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4 Test specimens

4.1 General

The specimen shall be representatives of the product. The size, the thickness and the number of specimens shall be as specified in 4.2 to 4.4, or otherwise selected ensuring that their moisture adsorption/desorption properties are properly evaluated.

4.2 Size

The size of a specimen shall be at most 250 mm × 250 mm but shall not be less than 100 mm × 100 mm.

4.3 Thickness

The thickness of a specimen shall be the same as the thickness of the product.

4.4 Number of specimens

The number of specimens shall be one piece for each test condition.

5 Test apparatus

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The test apparatus consists of an electronic balance, a moisture-proof box with a programmable air conditioner and a thermometer, as shown in Figure 1. An apparatus of any structure may be used as long as the criteria of measurement precision described for the different pieces of equipment (5.1 to 5.4) are satisfied.

5.1 Electronic balance, capable of weighing to the nearest 0,01 g for test specimens up to 6 kg.

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For test specimens exceeding 6 kg, an electronic balance capable of weighing to the nearest 0,1 g may be used.

5.2 Moisture-proof box with thermostat and/or hygrostat, equipped with a programmable air conditioner capable of being set at a specific temperature and humidity, having sufficient capacity to accommodate the specimen and containing the elements listed in 5.2.1 to 5.2.4.

5.2.1 Temperature sensor, positioned about 50 mm from the centre of the adsorption/desorption surface of the specimen and enabling the temperature to be maintained throughout the moisture-proof box to within ± 0,5 °C.

5.2.2 Humidity gauge, of which the sensor of the hygrometer is positioned about 50 mm from the centre of the moisture adsorption/desorption surface of the specimen and enables the humidity to be maintained throughout the moisture-proof box to within ± 3 % at any position.

5.2.3 Humidifier, using water vapour as the humidification source.

Humidification methods that involve spraying water with an ultrasonic humidifier, or similar devices, shall not be employed. When humidity is changed stepwise, the desired humidity shall be reached quickly (as a rule, in less than 10 min).

NOTE Salt saturated solutions can be used to adjust the relative humidity as indicated in Annex B.

5.2.4 Windscreen, set up to prevent any influence from airflow of the air conditioner.

5.3 Thermometer, capable of measuring the temperature to within ± 0,1°C.

5.4 Hygrometer, capable of measuring the humidity to within ± 2 %.

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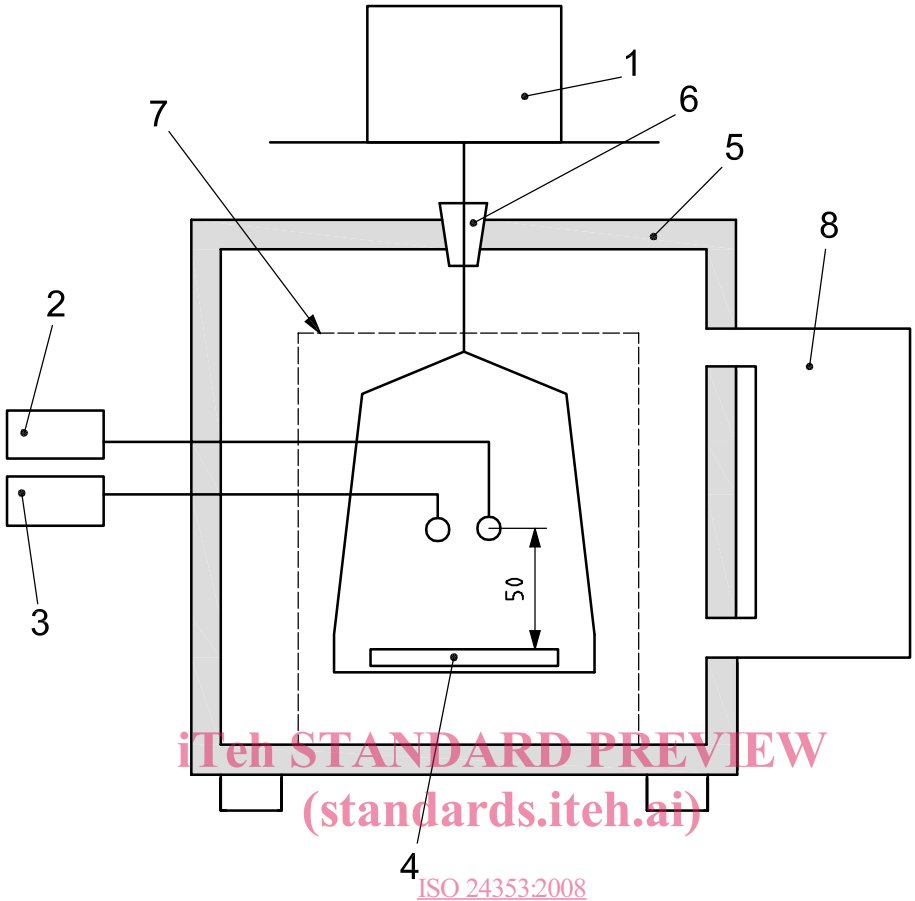
Dimensions in millimetres



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Key

1 electronic balance
2 hygrometer
3 thermometer
4 specimen
5 moisture-proof box
6 rubber plug
7 windscreen
8 programmable air conditioner

Figure 1 — Typical test apparatus

6 Setting of water vapour surface resistance

Air flow a along the surface of a specimen should be adjusted using a fan to stir the air inside the moisture-proof box (see Annex A) so as to obtain water vapour surface resistance, as measured in A.5, equal to (13,3 ± 1,3) m^2·h·Pa/μg.

7 Test method

7.1 Test conditions

For preconditioning and testing of a specimen, set the ambient temperature to (23 ± 0,5) °C, then maintain the ambient relative humidity to within ± 1 % of the value of relative humidity selected for testing.

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7.2 Single cycle test of moisture adsorption/desorption content

7.2.1 Preconditioning of the specimen

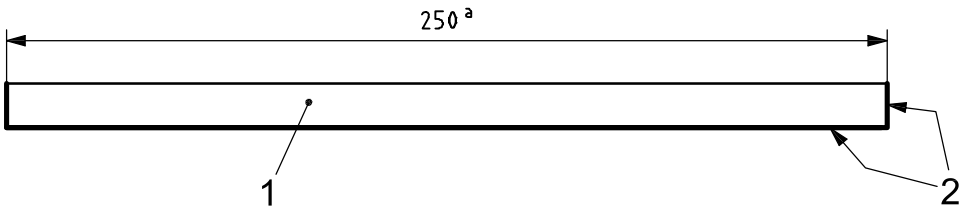
Precondition the specimen until it reaches constant mass, m_0, at a given ambient relative humidity as specified in Table 1.

A specimen shall be considered as having reached constant mass during the moisture adsorption process when the rate of increase in mass of adsorbed moisture is less than 0,01 g in 24 h.

7.2.2 Moisture barrier of test specimen

Provide a moisture barrier consisting of aluminium foil or other appropriate material and cover the entire surface of the specimen except for a single adsorption/desorption face.

Dimensions in millimetres



Key

1 test specimen

2 moisture barrier (aluminium sheet or the like)

a Length of moisture adsorption/desorption area.

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Figure 2 — Moisture barrier of test specimen

7.2.3 Test procedure

The test shall be carried out in two steps:

a) Step 1: with relative humidity set at one value for the moisture adsorption process;

b) Step 2: with relative humidity set at a lower value for the desorption process.

Typical humidity values are given for reference in Table 1.

Place the preconditioned test specimen into the test apparatus and quickly bring the water vapour surface resistance of the test specimen to the same value as that set for the calibration specimen.

With water vapour surface resistance thus adjusted, maintain the relative humidity at the Step 1 value for 12 h, then lower it to the Step 2 value and maintain it at this value for 12 h.

Measure the change in mass of the test specimen over a consecutive 24 h period. Take the mass at the beginning of the 12 h Step 1 period to be zero, then measure the mass of the test specimen (m_n) at 10 min intervals to the nearest 0,01 g. Record the mass at the end of the first 12 h period, the moisture adsorption process, as m_a, and at the end of the second 12 h period, the moisture adsorption process, as m_d.

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