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Hygrothermal performance of building materials and products — Determination of water-vapour transmission properties — Box method

Performance hydrothermique des matériaux et produits pour le bâtiment — Détermination des propriétés de transmission de la vapeur d'eau — Méthode de box

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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 21129 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

Introduction

The general principles are applicable to all hygroscopic and non hygroscopic building materials and products.

It is required to search for hygrothermal performance and thermal performance of building materials in order to solve the condensation phenomenon of building walls and to establish the condensation-preventive measures.

In the box method, a specimen is fixed to a measurement box. The mass of saturated salt solutions contained in two pans hanging on the two side boxes of a specimen is measured. The amount of water vapour penetrating through a specimen is calculated from change of the mass of the saturated salt solutions in the two pans.

In a cup method, the mass of the saturated salt solution is measured together with that of the specimen; however, in the box method, it is not necessary to measure the mass of the specimen.

The reason that the box method is more accurate than the cup method is that there are thick materials and/or heavy materials in building materials or products.

If the principle of the box method is applied, it is possible to measure the water-vapour transmission properties of not only materials but also some building products with good accuracy.

Hygrothermal performance of building materials and products — Determination of water-vapour transmission properties — Box method

1 Scope

This International Standard specifies a box method for determining the water-vapour permeability of building materials. The box method is used primarily to measure the water-vapour permeance of materials that have low water-vapour resistance, in which the influence of the surface-humidity transmission-resistance cannot be ignored.

NOTE Materials with low water-vapour resistance includes those with no greater than $1{,}8 \times 10^9 \cdot m^2 \cdot s \cdot Pa/kg$ of resistance [water vapour permeability coefficient of $5{,}5 \times 10^{-8} kg/(m^2 \cdot s \cdot Pa$ or above)].

2 Normative references

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.

ISO 9346, *Hygrothermal performance of buildings and building materials — Mass transfer — Physical quantities and definitions*

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the definitions given in ISO 9346 and the following apply.

3.1.1
density of water vapour flow rate
mass of water vapour transferred through per unit area per unit time under specified conditions of temperature, humidity and thickness

3.1.2
water vapour permeance
density of water vapour flow rate divided by the water vapour pressure difference between the two surfaces of the specimen

3.1.3
water vapour conductivity
water vapour permeance per unit thickness

3.1.4
water vapour resistance
reciprocal of water vapour permeance

3.1.5
water vapour permeability
product of the water vapour permeance and the thickness of a homogeneous specimen

3.2 Symbols and units

Symbol	Quantity	Unit
W_p	Water-vapour permeance of specimen	kg/(m^2·s·Pa)
Z_p	Water-vapour resistance of specimen	m^2·s·Pa/kg
G	Water-vapour flow rate through specimen	kg/h
A	Area of specimen	m^2
P	Water-vapour pressure in box or room	Pa
φ	Relative humidity	
$1/\beta$	Water-vapour surfaces resistance	m^2·s·Pa/kg
β	Surface coefficient of water-vapour transfer	kg/(m^2·s·Pa)
δ_p	Water-vapour permeability of specimen	kg/(m·s·Pa)
d	Thickness of specimen	m

Subscripts:

High High water vapour pressure side.

Low Low water vapour pressure side.

See References [1] to [5] for further details.

4 Principle

Install a box (called the water-vapour-permeability test box) for measuring the amount of permeated water vapour in a room maintained at a constant temperature and humidity. To create a difference in water vapour pressure, i.e., a difference in humidity, between the two sides of the specimen, attach the test box to one face (opening) and then place a high- or low-density aqueous salt solution into the box and maintain the box at a constant humidity. During this time, water vapour flows from the box to the room or from the room to the box by permeating the specimen. The amount of vapour flow can be determined by measuring the change in mass of the dish containing the aqueous salt solution by taking measurements at constant intervals using a scale (electronic balance); see Figure 1. In this way, the total water-vapour resistance, including the surface-transmission-resistance of the material, can be calculated by measuring the vapour-pressure difference on both sides of the specimen at a steady state and a constant water-vapour permeance. The water-vapour resistance of the material can be calculated by subtracting the surface-humidity transmission-resistance on both sides of the specimen, obtained according to Annex B, from the total water vapour resistance.

5 Apparatus

NOTE See Figure 1.

5.1 Room, in which the temperature can be freely set within a range of 10 °C to 30 °C to an accuracy of at least ± 0,5 °C and the relative humidity of the room can be freely set within a range of (30 ± 3) % to (90 ± 3) %.

5.2 Water-vapour permeability test box, having the standard dimensions of 600 mm × 600 mm × 600 mm.

The measuring box should be made of material such as metal, glass or hard plastic that is impermeable to water vapour and, under the measurement criteria, it should be resistant to corrosion (anti-moisture material). The box joint shall be properly sealed to prevent water-vapour leakage. The box shall be constructed to provide sufficient strength for usage. The part connected to the sample installation frame at the opening (flange) shall be made of anti-moisture rubber packing or other material to enable air tightness.

5.3 Mixing fan, capable of blowing air along the surface of the specimen as uniformly as possible.

Average velocity of the air movement at a distance of 50 mm from the surface shall be adjusted to be 0,5 m/s.

5.4 Saturated-aqueous-salt solution dish, having an area at least equal to the area of the specimen.

The dish shall be resistant to corrosion from the salt solution and be of a construction to enable mass measurement by a balance.

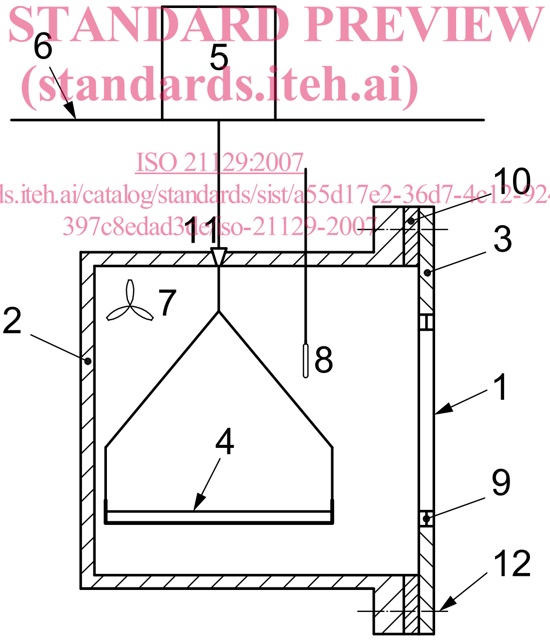
5.5 Balance, capable of weighing the pan with a precision of ± 10 mg.

5.6 Specimen installation frame, made of non-distorting, anti-moisture material.

It shall be constructed with an opening in the centre where the specimen can be placed, and enable secure air-tight attachment of the frame to the flange of the water-vapour test box. The opening dimensions shall be 300 mm × 300 mm. It shall have a flange-type shape to keep in thick specimens and have gaps to enable the sealing of small surface holes in the specimen.

5.7 Thermometers, two, capable of measuring the air temperature on both sides of the specimen to an accuracy of ± 0,1 °C.

5.8 Hygrometers, two, capable of measuring the relative humidity of both sides of the specimen to an accuracy of ± 2 %.



Key

1 specimen
2 measuring box
3 frame for specimen
4 suspended weighing pan
5 balance
6 room at constant temperature and humidity
7 mixing fan
8 thermometer and hygrometer
9 sealant
10 rubber gasket
11 rubber plug
12 clamp

Figure 1 — Test apparatus