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

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

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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).

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ISO 12572 was prepared by the European Committee Standardization (CEN) Technical Committee CEN/TC 89, *Thermal performance of buildings and building components*, in collaboration with ISO Technical Committee ISO/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 12572:2001), which has been technically revised with the following changes:

— addition of insulation materials in the Scope;

— addition of e) humidity chamber in Clause 5;

— addition of requirements regarding thickness of test specimen to measure the permeability of core materials in 6.2.3;

— change of specimen area size in 6.3;

— addition of requirements for storage time and relative humidity for condition D in 6.4;

— new clause with requirements in 6.5;

— change of requirements for temperature and relative humidity for test conditions in 7.1;

— change of the calculation of mass change rate in 8.1;

— removal of 9.8.

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

1 Scope

This document specifies a method based on cup tests for determining the water vapour permeance of building products and the water vapour permeability of building materials under isothermal conditions. Different sets of test conditions are specified.

The general principles are applicable to all hygroscopic and non-hygroscopic building materials and products, including insulation materials and including those with facings and integral skins. Annexes give details of test methods suitable for different material types.

The results obtained by this method are suitable for design purposes, production control and for inclusion in product specifications.

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.

There are no normative references in this document.

3 Terms, definitions, symbols, units and subscripts

3.1 Terms and definitions

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

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 http://www.iso.org/obp

3.1.1
density of water vapour flow rate
mass of water vapour transferred through the specimen per area and per time

3.1.2
homogeneous material
material with properties likely to affect the transmission of water vapour which do not vary on a macroscopic scale

3.1.3
impermeable material
material with a measured *water vapour diffusion-equivalent air layer thickness* (3.1.8) greater than 1 500 m

3.1.4
water vapour permeance
density of water vapour flow rate (3.1.1) divided by the water vapour pressure difference between the two specimen faces

3.1.5
water vapour resistance
reciprocal of *water vapour permeance* (3.1.4)

3.1.6
water vapour permeability
product of the *water vapour permeance* (3.1.4) and the thickness of a homogeneous specimen

Note 1 to entry: Water vapour permeability can only be calculated for specimens of a *homogeneous material* (3.1.2).

3.1.7
water vapour resistance factor
water vapour permeability (3.1.6) of air divided by that of the material concerned

Note 1 to entry: The water vapour resistance factor indicates how much greater the resistance of the material is compared to an equally thick layer of stationary air at the same temperature.

3.1.8
water vapour diffusion-equivalent air layer thickness
thickness of a motionless air layer which has the same *water vapour resistance* (3.1.5) as the specimen

3.2 Symbols and units

Symbol	Quantity	Unit
A	area of specimen	m^2
G	water vapour flow rate through specimen	kg/s
R_v	gas constant for water vapour = 462	N·m/(kg·K)
S	hydraulic diameter of specimen	m
T	thermodynamic temperature	K
W_p	water vapour permeance with respect to partial vapour pressure	kg/(m^2·s·Pa)
Z_p	water vapour resistance with respect to partial vapour pressure	m^2·s·Pa/kg
d	mean thickness of specimen	m
g	density of water vapour flow rate	kg/(m^2·s)
l	diameter of circle or side of square specimen	m
m	mass of specimen and cup assembly	kg
p	barometric pressure	hPa
p_0	standard barometric pressure = 1 013,25	hPa
S_d	water vapour diffusion-equivalent air layer thickness	m
t	time	s
Δp_v	water vapour pressure difference across specimen	Pa
δ_p	water vapour permeability	kg/(m·s·Pa)
δ_a	water vapour permeability of air	kg/(m·s·Pa)
μ	water vapour resistance factor	—
θ	celsius temperature	°C
φ	relative humidity	—

NOTE The above units comply with ISO 9346; a conversion table to other units commonly used in permeability measurements is given in Annex J.

3.3 Subscripts

Subscript	Denoting
I	interval
r	repeatability
a	air
c	corrected for air layer
f	film
j	joint
m	membrane
me	masked edge
s	specimen
t	total

4 Principle

The test specimen is sealed to the open side of a test cup containing either a desiccant (dry cup) or an aqueous saturated solution (wet cup). The assembly is then placed in a temperature and humidity controlled test chamber. Because of the different partial vapour pressure between the test cup and the chamber, a vapour flow occurs through permeable specimens. Periodic weighings of the assembly are made to determine the rate of water vapour transmission in the steady-state.

5 Apparatus

a) Test cups resistant to corrosion from the desiccant or salt solutions they contain; typically cups are made of glass or metal.

The design of cups suitable for testing various different types of materials is described in Annexes A to E.

NOTE Circular cups can be easier to seal and transparent cups allow better control of salt solutions.

b) For certain cups and sealing methods (see Annex A), a template, with shape and size corresponding to that of the test cup, is used when applying the sealant to give a sharply defined, reproducible test area. The template shall have an area of at least 90 % of the specimen to limit nonlinear vapour flow.

c) Measuring instruments capable of determining specimen thickness with accuracy required in 7.2.

d) Analytical balance, capable of weighing the test assembly with the repeatability needed for the required accuracy. Wherever possible, a balance of 0,001 g resolution shall be used. For heavy test assemblies, a balance resolution of 0,01 g may be sufficient (see Annex I for information linking the balance resolution to the duration of test).

NOTE The factors that affect the necessary accuracy of measurement are discussed in Annex I.

e) Constant temperature, constant humidity chamber, capable of being maintained within ±5 % relative humidity around the set point relative humidity and ±1,0 K around the set point temperature. In order to ensure uniform conditions throughout the chamber, the air shall be stirred so as to obtain velocities between 0,02 m/s and 0,3 m/s. If highly permeable materials are being tested, means should be provided to measure the air speed directly over the upper surface of the specimen (see Annex G).

f) Suitable sensors and a logging system to continuously record the temperature, relative humidity and, if necessary, the barometric pressure within the test chamber. The sensors shall be calibrated at regular intervals.