DRAFT INTERNATIONAL STANDARD
ISO/DIS 12572

ISO/TC **163**/SC **1** Secretariat: **DIN**

Voting begins on: **2014-12-04** Voting terminates on: **2015-05-04**

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

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

ICS: 91.120.10

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the European Committee for Standardization (CEN), and processed under the **CEN lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Reference number
ISO/DIS 12572:2014(E)

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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.

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 12572 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, and by Technical Committee CEN/TC 89, *Thermal performance of buildings and building components* in collaboration.

This second edition cancels and replaces the first edition (EN ISO 12572:2001), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

This standard is one of a series of standards which specify test methods for the thermal and moisture related properties of building materials and products.

The European publications to be used instead of the International Standards listed in clause 2 are given in normative annex ZA, which is an integral part of this European Standard.

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

1 Scope

This standard 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 those with facings and integral skins. Annexes give details of test methods suitable for different material types. If the measured water vapour diffusion-equivalent air layer thickness is greater than 1500 m the material can be considered impermeable.

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, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 - Physical quantities for mass transfer - Vocabulary*

3 Definitions, symbols and units

3.1 Terms and definitions

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

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

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

NOTE Water vapour permeability can only be calculated for specimens of a homogeneous material.

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

NOTE 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.

3.1.7
water vapour diffusion-equivalent air layer thickness
thickness of a motionless air layer which has the same water vapour resistance 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	$kg/(m^2 \cdot s \cdot Pa)$
Z_p	water vapour resistance with respect to partial vapour pressure	$m^2 \cdot s \cdot Pa/kg$
D	mean thickness of specimen	m
g	density of water vapour flow rate	$kg/(m^2 \cdot s)$
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 = 1013,25	hPa
s**Error! Objects cannot be created from editing field codes.**	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**Error! Objects cannot be created from editing field codes.**	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 non-linear 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 ± 3 % relative humidity around the set point relative humidity and ± 0,5 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.

g) Sealant, which is impermeable to water vapour, does not undergo physical or chemical changes during the test and does not cause physical or chemical changes to the specimen.

NOTE Examples of sealants suitable for specific materials, if necessary, are listed in the appropriate annex.

6 Test specimens

6.1 General principles for preparation of test specimens

The test specimens shall be representative of the product. If the product has natural skins or integral facings, these may be included in the test specimen, but they shall be removed if it is intended to measure the permeability of the core material. If the skins or facings are different on the two sides, specimens shall be tested with vapour flow in the direction of the intended use. If the direction of flow is not known, duplicate specimens shall be prepared and tests carried out for each direction of flow. Unless the product to be tested in isotropic, the test specimens shall be cut so that the parallel faces are normal to the direction of vapour flow of the product in use.

Specimen preparation shall not involve methods which damage the surface in ways which affect the flow of water vapour.

6.2 Dimensions of test specimens

6.2.1 Shape and fit

Test specimens shall be cut to correspond with the dimensions of the chosen test assembly - see annexes A to E.

6.2.2 Exposed area

The diameter of a circular specimen or the side of a square specimen shall be at least twice the specimen thickness. The exposed area (the arithmetic mean of the upper and lower free surface areas) shall be at least 0,005 m^2. The upper and lower free surface areas shall not differ by more than 3 % of the mean in the case of homogeneous materials, and by no more than 10 % in the case of other materials.

6.2.3 Thickness of test specimens.

Whenever possible, the thickness of the specimen shall be that of the product in use. In the case of homogeneous materials, if the thickness exceeds 100 mm, this may be reduced by cutting. In the case of non-homogeneous materials, such as concrete containing aggregates, the thickness should be at least three times (and preferably five times) the largest particle size.

If a material contains macroscopic formed voids, the solid material should be tested and the resistance of the whole material calculated from the proportions of solid to air space assuming one dimensional vapour flow.

If it is necessary to test a product so thick that the available test cups do not have an area large enough to comply with 6.2.2, the product may, only as a last resort, be sliced. In this case, all slices shall be tested and the results reported.

NOTE This procedure may lead to significant inaccuracies, especially when wet cup tests are carried out on hygroscopic materials.

