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SLOVENSKI STANDARD
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Higrotermalno obnašanje gradbenih materialov in proizvodov - Ugotavljanje lastnosti za prehod vodne pare (ISO 12572:2001)

Hygrothermal performance of building materials and products - Determination of water vapour transmission properties (ISO 12572:2001)

Wärme- und feuchtetechnisches Verhalten von Baustoffen und Bauprodukten - Bestimmung der Wasserdampfdurchlässigkeit (ISO 12572:2001)

Performance hygrothermique des matériaux et produits pour le bâtiment - Détermination des propriétés de transmission de la vapeur d'eau (ISO 12572:2001)

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91.100.01	Gradbeni materiali na splošno	Construction materials in general
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Hygrothermal performance of building materials and products - Determination of water vapour transmission properties (ISO 12572:2001)

Performance hygrothermique des matériaux et produits pour le bâtiment - Détermination des propriétés de transmission de la vapeur d'eau (ISO 12572:2001)

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This European Standard was approved by CEN on 18 October 2000.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

The text of EN ISO 12572:2001 has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS, in collaboration with Technical Committee ISO/TC 163 "Thermal insulation".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2001, and conflicting national standards shall be withdrawn at the latest by December 2001.

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.

The annexes A, B, C, D, E, F, G and ZA are normative.

The annexes H, J and ZB are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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. This standard is not applicable in the case of test specimens with water vapour diffusion-equivalent air layer thickness values less than 0,1 m, as a result of increasing uncertainty in the measurement results. 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

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

ISO 9346 *Thermal insulation - Mass transfer - Physical quantities and definitions*

3 Definitions, symbols and units

3.1 Terms and definitions

For the purposes of this standard, 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	$kg/(m^2·s·Pa)$
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 = 1013,25	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 with respect to partial vapour pressure	kg/(m·s·Pa)
δ_a	water vapour permeability of air with respect to partial vapour pressure	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 H 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 H.

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.

6.3 Number of test specimens

If the specimen area is less than 0,02 m^2, a minimum of five specimens shall be tested, otherwise a minimum of three specimens shall be tested.

6.4 Conditioning of test specimens

Before testing, the test specimens shall be stored at (23 ± 5) °C, (50 ± 5) % relative humidity for a period long enough for their weight to stabilise so that three successive daily determinations of their weight agree to within 5 %.

NOTE This period will vary from a few hours in the case of some insulating materials to 3 - 4 weeks or more for massive hygroscopic materials and products. Wet field specimens may be dried before conditioning using the methods specified in ISO 12570, *Hygrothermal performance of building materials and products - Determination of moisture content by drying at elevated temperature.*

A period of conditioning is not necessary in the case of plastic membranes.

7 Procedure

7.1 Test conditions

Select the desired test environment from the sets of conditions given in Table 1.

Table 1 - Test conditions

Set	**Condition** °C - % RH	**Tolerances**				
		Temperature °C	**Relative humidity** %			
			Dry state		Wet state	
			Set point	Tolerance	Set point	Tolerance
A	23 - 0/50	23 ± 0,5	0	+ 3	50	± 3
B	23 - 0/85	23 ± 0,5	0	+ 3	85	± 3
C	23 - 50/93	23 ± 0,5	50	± 3	93	± 3
D	38 - 0/93	38 ± 0,5	0	+ 3	93	± 3

NOTE 1 'Dry cup' tests (condition A) give information about the performance of materials at low humidities when moisture transfer is dominated by vapour diffusion. 'Wet cup' tests (condition C) give guidance about the performance of materials under high humidity conditions. At higher humidities, the material pores start to fill with water; this increases the transport of liquid water and reduces vapour transport. Tests in this area therefore give some information about liquid water transport within materials. This is discussed further in ISO 15148, *Hygrothermal performance of building materials and products - Determination of water absorption coefficient by partial immersion.*

Other sets of temperature and relative humidity may be agreed between the parties when needed for special application conditions.

NOTE 2 The following are examples of desiccants and saturated aqueous solutions which produce the specified air relative humidities at 23 °C:

a) Desiccants

Calcium chloride, $CaCl_2$ - particle size < 3 mm	0 %
Magnesium perchlorate, $Mg(ClO_4)_2$)	0 %

b) Aqueous solutions

Magnesium nitrate, $Mg(NO_3)_2$	53 %
Potassium chloride, KCl	85 %
Ammonium dihydrogen phosphate, $NH_4H_2PO_4$	93 %