SLOVENSKI STANDARD
SIST EN 12412-4:2003

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Toplotne lastnosti oken, vrat in polken – Ugotavljanje toplotne prehodnosti z metodo komorne naprave – 4. del: Roletne omarice

Thermal performance of windows, doors and shutters - Determination of thermal transmittance by hot box method - Part 4: Roller shutter boxes

Wärmetechnisches Verhalten von Fenstern, Türen und Abschlüssen - Bestimmung des Wärmedurchgangskoeffizienten mittels des Heizkastenverfahrens - Teil 4: Rollladenkästen

Performance thermique des fenetres, portes et fermetures - Détermination du coefficient de transmission thermique par la méthode de la boîte chaude - Partie 4: Coffres de volets roulants

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ICS:

91.060.50	Vrata in okna	Doors and windows
91.120.10	Toplotna izolacija stavb	Thermal insulation

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English version

Thermal performance of windows, doors and shutters - Determination of thermal transmittance by hot box method - Part 4: Roller shutter boxes

Performance thermique des fenêtres, portes et fermetures - Détermination du coefficient de transmission thermique par la méthode de la boîte chaude - Partie 4: Coffres de volets roulants

Wärmetechnisches Verhalten von Fenstern, Türen und Abschlüssen - Bestimmung des Wärmedurchgangskoeffizienten mittels des Heizkastenverfahrens - Teil 4: Rolladenkästen

This European Standard was approved by CEN on 2 May 2003.

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

This document EN 12412-4:2003 has been prepared by Technical Committee CEN /TC 89, "Thermal performance of buildings and building components", the secretariat of which is held by SIS.

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 January 2004, and conflicting national standards shall be withdrawn at the latest by January 2004.

This standard is one of a series of standards on calculation and measurement methods for the design and evaluation of the thermal performance of buildings and building components.

Annexes A and B are normative.

Annex C is 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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The method described in this European Standard provides data that can be used for calculating the overall thermal performance of windows and doors equipped with roller shutters according to EN ISO 10077-1, *Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: Simplified method (ISO 10077-1:2000).*

1 Scope

This European Standard specifies a method, based on EN ISO 8990 and EN ISO 12567-1, to measure the overall thermal transmittance of a roller shutter box in a hot box. This includes all effects of geometrical and material characteristics in a test specimen.

Edge effects occurring outside of the perimeter of the specimen are excluded. Furthermore, energy transfer due to solar radiation is not taken into account, and air leakage is excluded.

The method is designed to provide both standardised tests which enable a fair comparison of different products to be made, and specific tests on products for practical application purposes. The former includes window standardised specimen sizes and applied test criteria.

The determination of the overall thermal transmittance is performed for conditions which will correspond to a similar situation of the roller shutter box in practice.

Information on the design of the calibration transfer standard is given in EN ISO 12567-1.

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).

EN 1946-4, *Thermal performance of building products and components – Specific criteria for the assessment of laboratories measuring heat transfer properties – Part 4: Measurements by hot box methods.*

prEN 12519:1996, *Windows and doors – Terminology.*

EN 12664, *Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Dry and moist products of medium and low thermal resistance.*

EN ISO 7345:1995, *Thermal insulation – Physical quantities and definitions (ISO 7345:1987).*

EN ISO 8990:1996, *Thermal insulation – Determination of steady-state thermal transmission properties – Calibrated and guarded hot box (ISO 8990:1994).*

EN ISO 9288:1996, *Thermal insulation – Heat transfer by radiation – Physical quantities and definitions (ISO 9288:1989).*

EN ISO 12567-1:2000, *Thermal performance of windows and doors – Determination of thermal transmittance by hot box method – Part 1: Complete windows and doors (ISO 12567-1:2000).*

3 Terms, definitions, symbols, units and subscripts

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 7345:1995, EN ISO 8990:1996, EN ISO 9288:1996 and prEN 12519:1996 apply.

3.2 Symbols and units

Symbol	Quantity	Unit
A	area	m^2
F	convective fraction	–
R	thermal resistance	$m^2 \cdot K/W$
T	thermodynamic temperature	K
U	thermal transmittance	$W/(m^2 \cdot K)$
d	thickness or depth	m
f	view factor	–
h	surface coefficient of heat transfer	$W/(m^2 \cdot K)$
L	perimeter length	m
l	length	m
q	density of heat flow rate	W/m^2
$\Delta\theta$, ΔT	temperature difference	K
Λ	thermal conductance	$W/(m^2 \cdot K)$
α	radiation factor	–
Φ	heat flow rate	W
ε	hemispherical emissivity	–
σ	Stefan-Boltzmann constant	$W/(m^2 \cdot K^4)$
θ	Celsius temperature	°C
Ψ	linear thermal transmittance	$W/(m \cdot K)$
w	width	m
v	air velocity	m/s
λ	thermal conductivity	$W/(m \cdot K)$

3.3 Subscripts

b	baffle
c	convective
ca	calibration
e	external, usually cold side
ed	edge zone
fi	infill with known thermal properties
hb	hot box
i	internal, usually hot side
in	input
m	measured
me	average
n	environmental (ambient)

ne	environmental (external)
ni	environmental (internal)
p	reveal of surround panel
r	radiation (mean)
s	surface
sb	roller shutter box
sp	specimen
sur	surround panel
t	total

4 Principle

Tests are carried out using the calibrated or guarded hot box in accordance with EN ISO 8990 and EN ISO 12567-1. Depending on the height of the box, roller shutter boxes located in pairs of the same type of construction equipped with masks (simulation of window frames) form the test specimen.

The surround panel is used to keep the specimen in position. It is constructed with outer dimensions of appropriate size for the apparatus, having an aperture to accommodate the specimen (see Figures 1 and 2).

The principal heat flows through the surround panel and the calibration panel (or test specimen) are shown in Figure 3. The boundary edge heat flow due to the location of the calibration panel in the surround panel is determined separately by a linear thermal transmittance Ψ.

The procedure in this standard includes a correction for the boundary edge heat flow, so that standardized and reproducible thermal transmittance properties are obtained.

The magnitude of the boundary edge heat flow as a function of geometry, calibration panel thickness and thermal conductivity is determined by tabulated values given in annex B.

5 Requirements for test specimen and apparatus

5.1 General

The test apparatus shall conform to the requirements specified in EN 1946-4, EN ISO 8990 and EN ISO 12567-1.

5.2 Surround panels

For details see 5.2 of EN ISO 12567-1:2000.

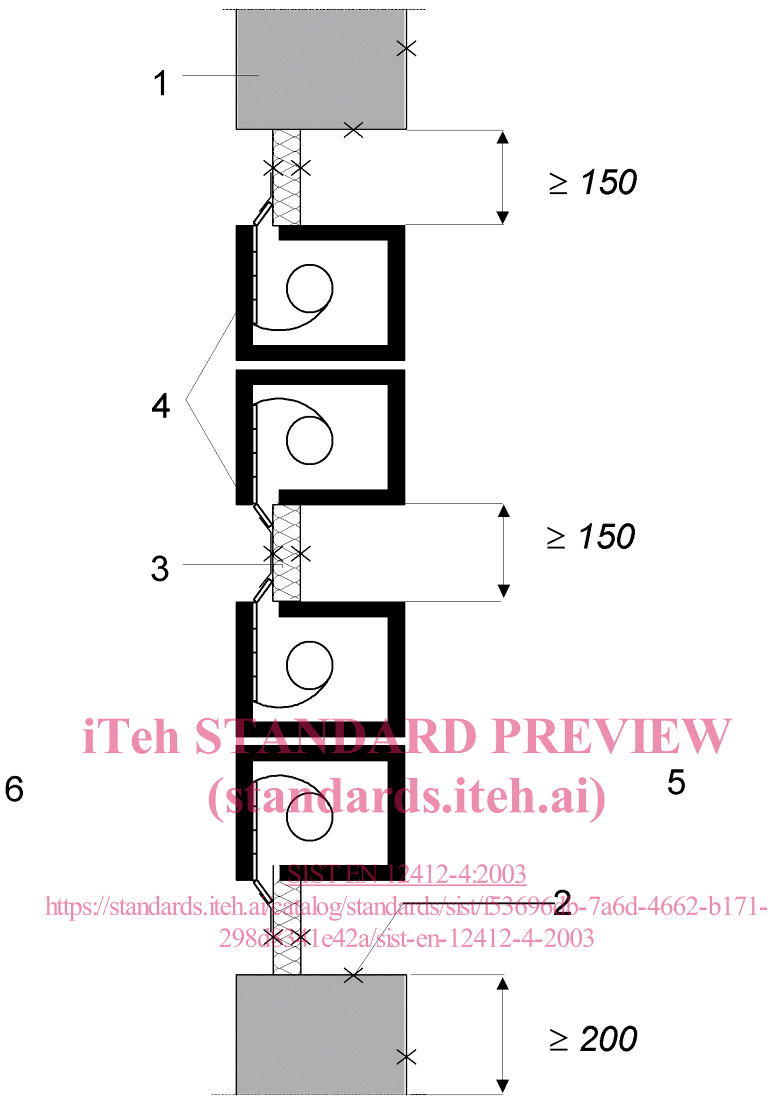
5.3 Specimen requirements and location

The roller shutter boxes shall be at least 1230 mm long and shall be mounted horizontally in the aperture (see Figure 1). For test specimens with metallic-bare surfaces, the inner and outer surfaces should be treated by coating in order to achieve an emissivity of at least 0,8. Any variations from this value have to be justified. Adjacent roller shutter boxes located in pairs lying on top of each other are separated by insulating panels (infill elements). These panels shall be made from material with thermal conductivity less than 0,035 W/(m·K) and shall be at least 150 mm high and 60 mm thick. The thermal conductivity of the insulating infill elements shall be obtained by measurement according to EN 12664 (guarded hot plate apparatus) or by using panels with certified properties from an accredited source.

Thermocouples to measure the surface temperature shall be placed as shown in Figure 2.

For further information refer to EN ISO 12567-1.

Dimensions in millimetres



Key

1	Surround panel	4	Roller shutter box
2	Temperature sensors	5	Warm side
3	Panel (infill element)	6	Cold side

Figure 1 — Roller shutter boxes in surround panel

It is important that this infill element is located in the same position as the window shutter box would be in practice. The surround panel shall always be thicker than the depth of the shutter box so that the shutter box does not protrude on either side.

The roller shutter boxes shall be tested as used in practice during the night-time, i.e. with roller shutters rolled down.

The roller shutters shall be shortened to the last 4 to 7 slats. The last slat of each shutter box shall be taken to the outside and taped to the insulating panel.

If the specimen area forms less than 30 % of the aperture area of the hot-box, two or more shutter boxes shall be installed so that the total specimen area is at least 30 % of the aperture area, with at least 150 mm between the pair of shutter boxes (see Figure 1).

5.4 Calibration panels

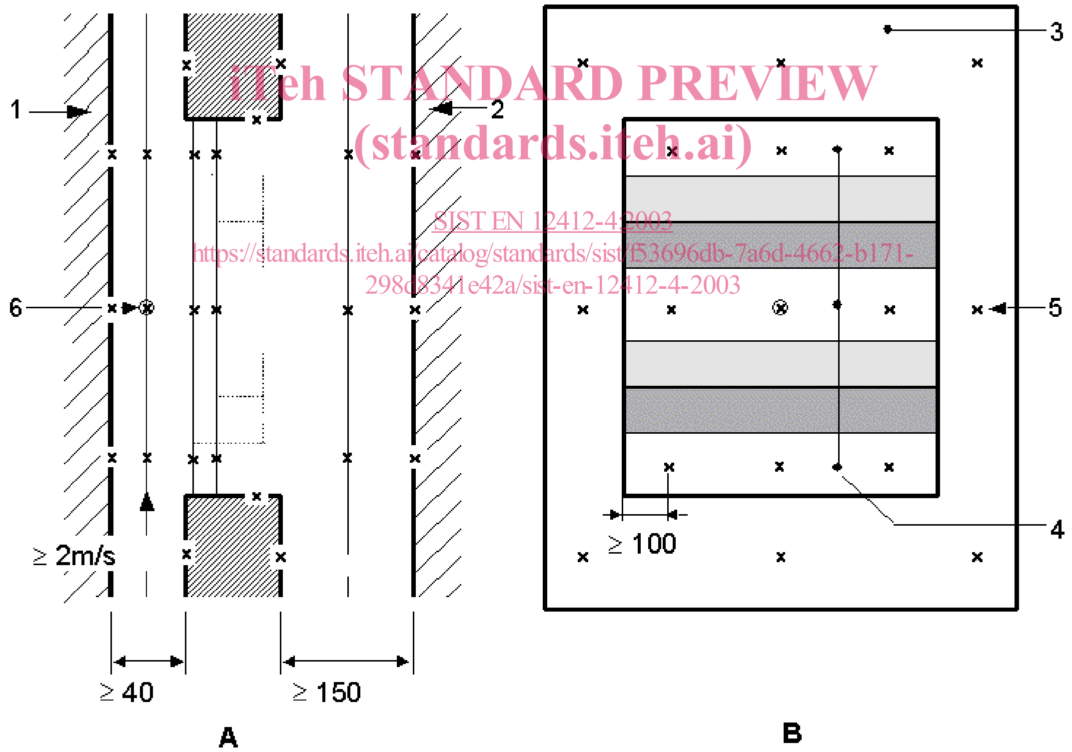
The calibration panel shall be mounted as shown in Figure 3. For further details see 5.4 and 5.5 of EN ISO 12567-1:2000.

5.5 Temperature measurement and baffle position

For further details see 5.5 of EN ISO 12567-1:2000.

The position of the temperature and the air speed sensors are shown in Figure 2.

Dimensions in millimetres



Key

A	Vertical section	3	Surround panel
B	Face elevation	4	Infill element
1	Cold side baffle	5	Thermocouple
2	Warm side baffle	6	Air speed sensor

Figure 2 — Locations of temperature and air speed sensors during measurement

5.6 Air flow measurements

See 5.6 of EN ISO 12567-1:2000.

6 Test procedure

6.1 General

Except as provided herein, the test procedure shall conform with the requirements according to 6.2 and 6.3 of EN ISO 12567-1:2000. An example of the calculations required is given in annex C.

6.2 Calibration measurements

6.2.1 General

Calibration measurements are required to ensure that suitable test conditions are set up and that the surround panel heat flow and surface heat transfer coefficients can be fully accounted for.

The calibration measurements shall be carried out at a minimum of six densities of heat flow rates which cover the required range of specimen testing.

Calibration measurements shall be carried out at three different mean air temperatures $\theta_{c,me}[\theta_{c,me}=(\theta_{c,i} + \theta_{c,e})/2]$ in steps of ± 5 K by varying the cold side air temperature, retaining constant conditions of air movement on the cold side and constant air temperature and natural convection on the warm side. By this procedure, surface resistances and coefficients of heat transfer can be determined as a function of the total density of heat flow rate through the calibration panel.

NOTE It is considered that for non-homogeneous test specimens like window frames or door frames, the mean heat transfer conditions over the measured area will be comparable to those of the given calibration panel.

6.2.2 Total surface resistance

6.2.2.1 Measurement

The calibration panels shall be made as specified in C.1 of EN ISO 12567-1:2000, and the calibration measurements shall be carried out as specified in 6.2 of EN ISO 12567-1:2000 (see also Figure 3).

The first calibration test shall be made with the thin panel ($d_{ca} \approx 20$ mm) at a mean temperature of approximately 10 °C and a temperature difference, $\Delta\theta_c$ between warm and cold sides, of (20 ± 2) K (see EN ISO 8990 and annex A for the determination of the environmental temperatures).

The air velocity on the cold side shall be adjusted for the first calibration test by throttling or by fan speed adjustment to give a total surface thermal resistance (warm and cold side) $R_{s,t}$ = 0,17 ± 0,01 $m^2 \cdot K/W$. Thereafter, the fan speed settings and/or the throttling devices shall remain constant for all subsequent calibration measurements. The set-up used for the calibration procedure shall be used for all tests with specimens of shutter boxes.

6.2.2.2 Calculation

Calculate the total surface thermal resistance of the warm and cold side, $R_{s,t}$, expressed in m^2K/W, using Equation (1):

$$R_{s,t} = \frac{\Delta\theta_{n,ca} - \Delta\theta_{s,ca}}{q_{ca}} \quad (1)$$

where

$\Delta\theta_{n,ca}$ is the difference between environmental temperatures on each side of the calibration panel, in K, calculated in accordance with annex A;

$\Delta\theta_{s,ca}$ is the surface temperature difference of the calibration panel, in K;

q_{ca} is the density of heat flow rate of the calibration panel determined from the known thermal resistance R_{ca} of the calibration panel (at the mean temperature, $\theta_{me,ca}$) and the surface temperature difference $\Delta\theta_{s,ca}$ calculated using Equation (2):

$$q_{ca} = \frac{\Delta\theta_{s,ca}}{R_{ca}} \quad (2)$$

where R_{ca} is the thermal resistance of the calibration panel at the mean temperature of the panel, calculated using Equation (3):

$$R_{ca} = \sum \frac{d_j}{\lambda_j} \quad (3)$$

The total surface resistance, $R_{s,t}$, shall be plotted as a function of the density of heat flow rate, q_{ca}, of the calibration panel. These characteristics are used to determine the total surface resistances of all subsequent measurements of test specimens.

6.2.3 Surface resistance and surface coefficients of heat transfer

6.2.3.1 General

Surface coefficients of heat transfer (convective and radiative parts) are needed in order to determine the environmental temperatures (according to the procedures given in annex A and EN ISO 8990). Surface temperature measurements on the calibration panel at different densities of heat flow rate allow the determination of the surface coefficients of heat transfer. The surface resistances are calculated using Equations (4) and (5):

$$R_{si,t} = \frac{\Delta\theta_{ni,ca} - \Delta\theta_{si,ca}}{q_{ca}} \quad (4)$$

$$R_{se,t} = \frac{\Delta\theta_{ne,ca} - \Delta\theta_{se,ca}}{q_{ca}} \quad (5)$$

where

q_{ca} is the density of heat flow rate through the calibration panel, in W/m^2;

$\theta_{ni,ca}$ is the environmental temperature of the warm side, in degrees Celsius;

$\theta_{si,ca}$ is the warm side surface temperature of the calibration panel, in degrees Celsius;

$\theta_{se,ca}$ is the cold side surface temperature of the calibration panel, in degrees Celsius;

$\theta_{ne,ca}$ is the environmental temperature of the cold side, in degrees Celsius.

NOTE The calculation of environmental temperatures is described in annex A.

6.2.3.2 Convective fraction

Evaluate the radiative and convective parts of the surface coefficients of heat transfer from the calibration data for the warm and cold side according to the procedure given in annex A and determine the convective fraction F_c using Equation (6):