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Incorporating corrigendum November 2010



BSI Standards Publication

Thermal performance of windows and doors — Determination of thermal transmittance by the hot-box method

Part 1: Complete windows and doors (ISO
12567-1:2010)

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National foreword

This British Standard is the UK implementation of EN ISO 12567-1:2010. It is identical to ISO 12567-1:2010, incorporating corrigendum November 2010. It supersedes BS EN ISO 12567-1:2000 which is withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the by tags. Text altered by ISO corrigendum November 2010 is indicated in the text by AC1 AC1.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Thermal performance of windows and doors - Determination of
thermal transmittance by the hot-box method - Part 1: Complete
windows and doors (ISO 12567-1:2010)

Isolation thermique des fenêtres et portes - Détermination
de la transmission thermique par la méthode à la boîte
chaude - Partie 1: Fenêtres et portes complètes (ISO
12567-1:2010)

Wärmetechnisches Verhalten von Fenstern und Türen -
Bestimmung des Wärmedurchgangskoeffizienten mittels
des Heizkastenverfahrens - Teil 1: Komplette Fenster und
Türen (ISO 12567-1:2010)

This European Standard was approved by CEN on 2 June 2010.

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Foreword

This document (EN ISO 12567-1:2010) has been prepared by Technical Committee ISO/TC 163 "Thermal performance and energy use in the built environment" in collaboration with 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of an identical text or by endorsement, at the latest by January 2011, and conflicting national standards shall be withdrawn at the latest by January 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 12567-1:2000.

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Endorsement notice

The text of ISO 12567-1:2010 has been approved by CEN as a EN ISO 12567-1:2010 without any modification.

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	2
3.1 Terms and definitions	2
3.2 Symbols	2
4 Principle	4
5 Requirements for test specimens and apparatus	10
5.1 General	10
5.2 Surround panels	10
5.3 Test specimens	10
5.4 Calibration panels	12
5.5 Temperature measurements and baffle positions	12
5.6 Air flow measurement	12
6 Test procedure	13
6.1 General	13
6.2 Calibration measurements	14
6.3 Measurement procedure for test specimens	17
6.4 Expression of results for standardized test applications	17
7 Test report	18
Annex A (normative) Environmental temperatures	19
Annex B (normative) Linear thermal transmittance of the edge zone	23
Annex C (informative) Design of calibration transfer standard	26
Annex D (informative) Example of calibration test and measurement of window specimen	30
Annex E (informative) Analytical calibration procedure using heat balance equations	39
Annex F (informative) Uncertainty analysis for hot boxes	41
Bibliography	52

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.

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ISO 12567-1 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

This second edition cancels and replaces the first edition (ISO 12567-1:2000), which has been technically revised.

ISO 12567 consists of the following parts, under the general title *Thermal performance of windows and doors — Determination of thermal transmittance by the hot-box method*:

- *Part 1: Complete windows and doors*
- *Part 2: Roof windows and other projecting windows¹⁾*

1) It is intended that, upon revision, the main element of the title of Part 2 will be aligned with the main element of the title of Part 1.

Introduction

The method specified in this part of ISO 12567 is based on ISO 8990. It is designed to provide both standardized tests, which enable a fair comparison of different products to be made, and specific tests on products for practical application purposes. The former specifies standardized specimen sizes and applied test criteria.

The determination of the aggregate thermal transmittance is performed for conditions which are similar to the actual situation of the window and door in practice.

Thermal performance of windows and doors — Determination of thermal transmittance by the hot-box method —

Part 1: Complete windows and doors

1 Scope

This part of ISO 12567 specifies a method to measure the thermal transmittance of a door or window system. It is applicable to all effects of frames, sashes, shutters, blinds, screens, panels, door leaves and fittings.

It is not applicable to

- edge effects occurring outside the perimeter of the specimen,
- energy transfer due to solar radiation on the specimen,
- effects of air leakage through the specimen, and
- roof windows and projecting products, where the external face projects beyond the cold side roof surface.

NOTE For roof windows and projecting units, see the procedure given in ISO 12567-2.

Annex A gives methods for the calculation of environmental temperatures.

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 7345, *Thermal insulation — Physical quantities and definitions*

ISO 8301, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus*

ISO 8302, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Guarded hot plate apparatus*

ISO 8990:1994, *Thermal insulation — Determination of steady-state thermal transmission properties — Calibrated and guarded hot box*

ISO 9288, *Thermal insulation — Heat transfer by radiation — Physical quantities and definitions*

ISO 10211, *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

EN 12898, *Glass in building — Determination of the emissivity*

IEC 60584-1, *Thermocouples — Part 1: Reference tables*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 8990 and ISO 9288 apply.

3.2 Symbols

For the purposes of this document, the physical quantities given in ISO 7345 and ISO 9288 apply, together with those given in Tables 1 and 2.

Table 1 — Symbols and units

Symbol	Physical quantity	Unit
A	Area	m^2
d	Thickness (depth)	m
F	Fraction	—
f	View factor	—
h	Surface coefficient of heat transfer	$\text{W}/(\text{m}^2 \cdot \text{K})$
H	Height	m
L	Perimeter length	m
q	Density of heat flow rate	W/m^2
R	Thermal resistance	$\text{m}^2 \cdot \text{K}/\text{W}$
T	Thermodynamic temperature	K
U	Thermal transmittance	$\text{W}/(\text{m}^2 \cdot \text{K})$
v	Air speed	m/s
w	Width	m
α	Radiant factor	—
$\Delta T, \Delta \theta$	Temperature difference	K
ε	Total hemispherical emissivity	—
θ	Temperature	$^{\circ}\text{C}$
λ	Thermal conductivity	$\text{W}/(\text{m} \cdot \text{K})$
σ	Stefan-Boltzmann constant	$\text{W}/(\text{m}^2 \cdot \text{K}^4)$
Φ	Heat flow rate	W
ψ	Linear thermal transmittance	$\text{W}/(\text{m} \cdot \text{K})$

Table 2 — Subscripts

Subscript	Significance
b	Baffle
c	Convection (air)
cal	Calibration
e	External, usually cold side
i	Internal, usually warm side
$\overline{AC_1}$ IN $\overline{AC_1}$	Input
m	Measured
me	Mean
n	Environmental (ambient)
ne	Environmental (ambient) external
ni	Environmental (ambient) internal
p	Reveal of surround panel
r	Radiation (mean)
s	Surface
se	Exterior surface, usually cold side
si	Interior surface, usually warm side
sp	Specimen
st	Standardized
sur	Surround panel
t	Total
W	Window
WS	Window with closed shutter or blind
D	Door

Table 3 — Symbols for uncertainty analysis for hot boxes

A_{sp}	Test specimen projected area	m ²
A_{sur}	Surround panel projected area	m ²
H_{sp}	Test specimen height	m
H_{sur}	Surround panel height	m
λ_{sur}	Surround panel thermal conductivity	W/m·K
d_{sp}	Test specimen thickness (depth)	m
d_{sur}	Surround panel thickness (depth)	m
P	Confidence level	%
Φ_{EXTR}	Extraneous heat transfer in the metering chamber	W
$\Phi_{FL,sp}$	Test specimen flanking heat transfer	W
Φ_{IN}	Total power input to the metering chamber	W
Φ_{sp}	Heat transfer through the test specimen	W
Φ_{sur}	Heat transfer through the surround panel	W
R	Dependent variable	
s_y	Sample standard deviation of measured values of variable	y
θ_n	Hot-box ambient air temperature	°C
θ_e	Cold side (climatic chamber) external air temperature	°C
θ_i	Warm side (metering room) internal air temperature	°C
$t_{v,P}$	t value of v 's degree of freedom and P 's confidence level	
U_{CTS}	Calibration transfer standard (CTS) thermal transmittance	W/m ² ·K

Table 3 (continued)

U_{sp}	Test specimen thermal transmittance	W/m ² ·K
U_{st}	Standardized test specimen thermal transmittance	W/m ² ·K
V	Metering chamber wall thermopile voltage	mV
w_{sp}	Test specimen width	m
w_{sur}	Surround panel width	m
x_i	Independent variable, $i = 1, 2, \dots, N$	
y_c	Calculated value of dependent variable y	
z	Independent variable	
θ_{AMB}	External ambient temperature	°C
$\theta_{me,sur}$	Surround panel mean temperature	°C
σ	Stefan-Boltzmann constant, 5.669×10^{-8}	W/m ² ·K ⁴
Δ	Uncertainty, difference	
$\delta\theta$	Temperature, difference	°C
$\delta\theta_{ie}$	Air temperature difference between warm and cold side chambers	°C
∂	Partial derivative	
ν	Degree of freedom	
$\delta\theta_{sur}$	Surround panel surface temperature difference	°C
The uncertainty analysis for hot boxes is given in Annex F.		

4 Principle

The thermal transmittance, U , of the specimen is measured by means of the calibrated or guarded hot-box method in accordance with ISO 8990.

The determination of the thermal transmittance involves two stages. Firstly, measurements are made on two or more calibration panels with accurately known thermal properties, from which the surface coefficient of the heat transfer (radiative and convective components) on both sides of the calibration panel with surface emissivities on average similar to those of the specimen to be tested and the thermal resistance of the surround panel are determined. Secondly, measurements are made with the window or door specimens in the aperture and the hot-box apparatus is used with the same fan settings on the cold side as during the calibration procedure.

The surround panel is used to keep the specimen in a given position. It is constructed with outer dimensions of appropriate size for the apparatus, having an aperture to accommodate the specimen (see Figures 1 to 4).

The principal heat flows through the surround panel and the calibration panel (or test specimen) are shown in Figure 5. 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 .

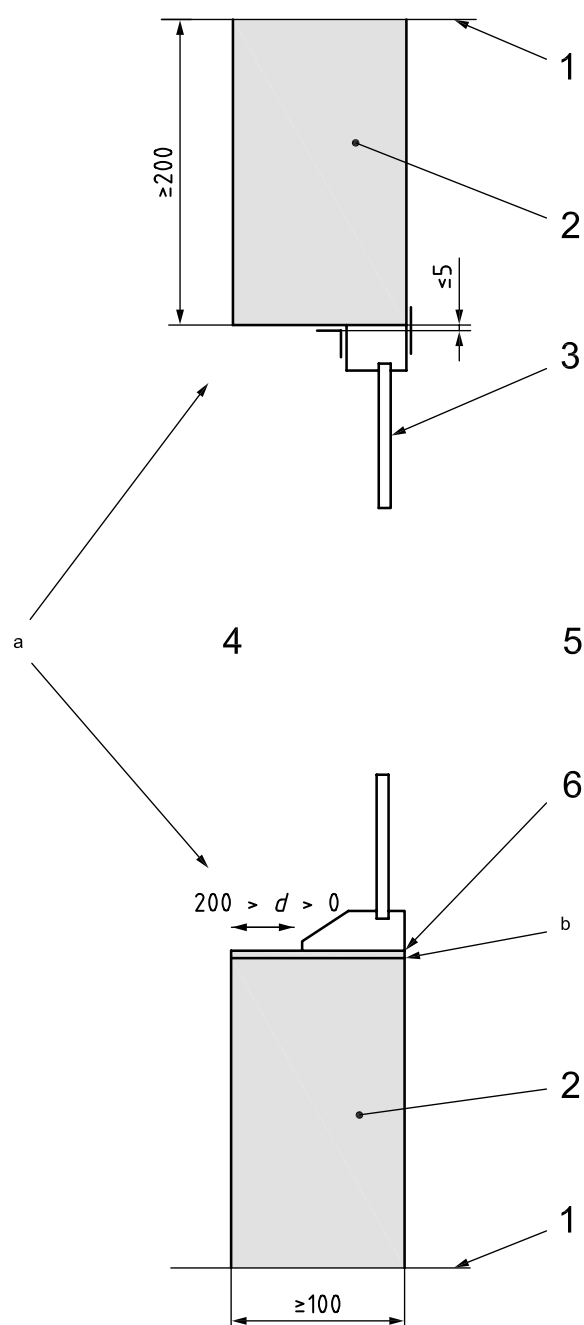
The procedure in this part of ISO 12567 includes a correction for the boundary edge heat flow, such that standardized and reproducible thermal transmittance properties are obtained.

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 or is calculated in accordance with ISO 10211.

Measurement results are corrected to standardized surface heat transfer coefficients by an interpolation or analytical iteration procedure, derived from the calibration measurements.

Measurements are taken (e.g. pressure equalization between the warm and cold side or sealing of the joints on the inside) to ensure that the air permeability of the test specimen does not influence the measurements.

Dimensions in millimetres



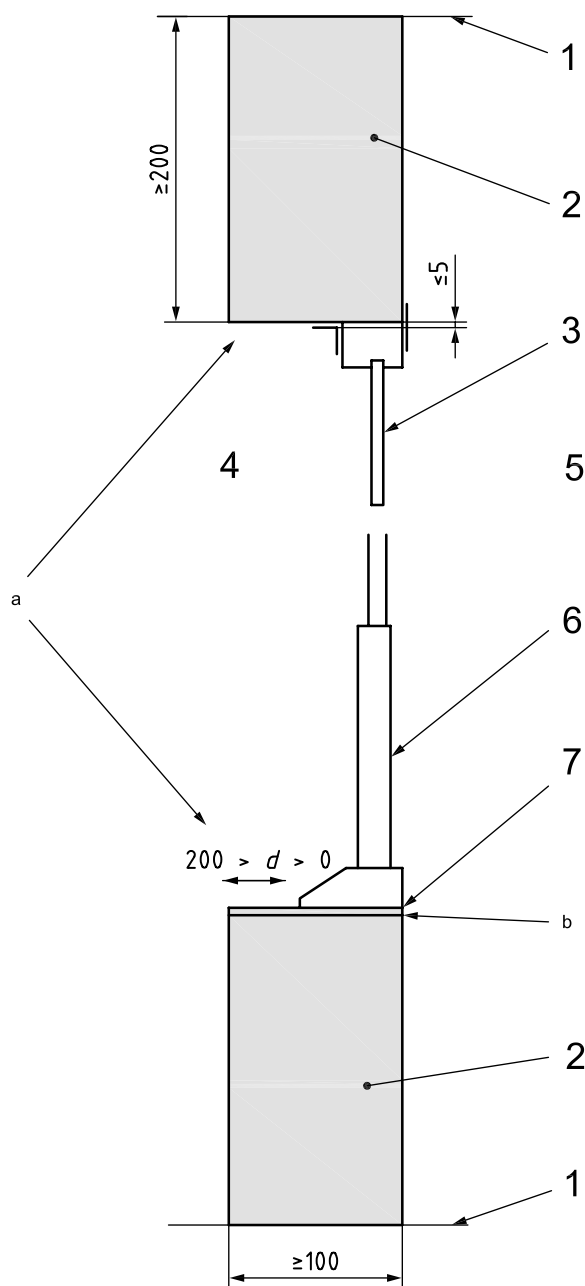
The total gap width between the top and bottom of the specimen and the surround panel aperture shall not exceed 5 mm. It shall be sealed with non-metallic tape or mastic material. The total gap width on both sides between the specimen and the surround panel aperture shall not exceed 5 mm.

Key

- | | | | |
|---|--|---|---|
| 1 | border of metering area | a | Metering area, centrally located in the surround panel, is recommended. |
| 2 | surround panel, $\lambda \leq 0,04 \text{ W/(m}\cdot\text{K)}$ | b | Use fill material with same thermal properties as surround panel core. |
| 3 | glazing | | |
| 4 | cold side | | |
| 5 | warm side | | |
| 6 | flush sill | | |

Figure 1 — Window system in surround panel

Dimensions in millimetres

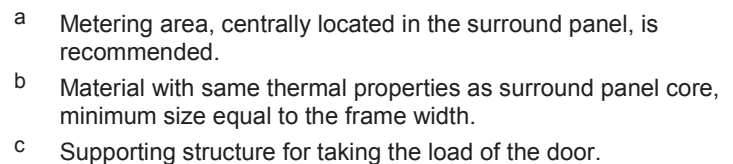


The total gap width between the top and bottom of the specimen and the surround panel aperture shall not exceed 5 mm. It shall be sealed with non-metallic tape or mastic material. The total gap width on both sides between the specimen and the surround panel aperture shall not exceed 5 mm.

Key

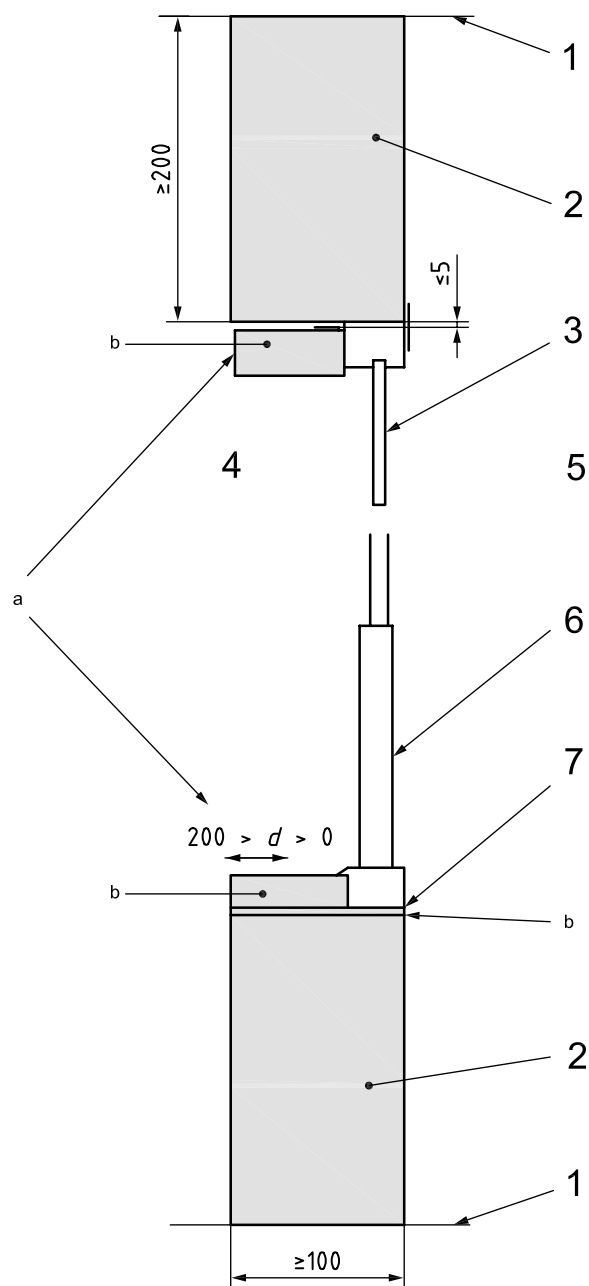
- | | | | |
|---|--|---|---|
| 1 | border of metering area | a | Metering area, centrally located in the surround panel, is recommended. |
| 2 | surround panel, $\lambda \leq 0,04 \text{ W/(m}\cdot\text{K)}$ | b | Use fill material with same thermal properties as surround panel core. |
| 3 | infill (glass, panel) | | |
| 4 | cold side | | |
| 5 | warm side | | |
| 6 | door leaf | | |
| 7 | flush frame/threshold | | |

Figure 2 — Door system in surround panel — Insert mounting



7

Dimensions in millimetres



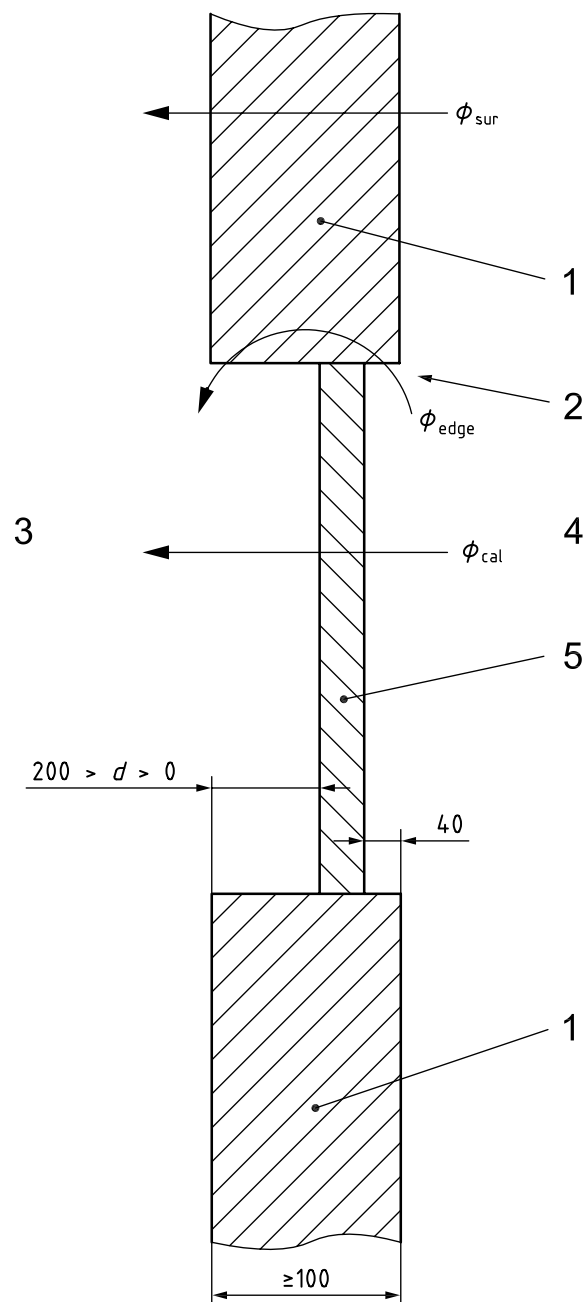
Key

- 1 border of metering area
- 2 surround panel, $\lambda \leq 0,04 \text{ W/(m}\cdot\text{K)}$
- 3 infill (glass, panel)
- 4 cold side
- 5 warm side
- 6 door leaf
- 7 flush frame/threshold

- a Metering area, centrally located in the surround panel, is recommended.
- b Use fill material with same thermal properties as surround panel core.

Figure 4 — Door system in surround panel — Inside mounting

Dimensions in millimetres



Key

- 1 surround panel
- 2 boundary effect
- 3 cold side
- 4 warm side
- 5 calibration panel

Figure 5 — Mounting of calibration panel in aperture

5 Requirements for test specimens and apparatus

5.1 General

The construction and operation of the apparatus shall comply with the requirements specified in ISO 8990, except where modified by this part of ISO 12567. To make heat transfer measurements on the specimen, the specimen shall be mounted in a suitable surround panel and the heat flow shall be deduced through it by subtracting that through the surround panel from the total heat input. Also, the test element and the surround panel are usually of different thickness, such that there is disturbance of heat flow paths and temperatures in the region of the boundary between the two. The test shall be carried out such that edge corrections can be applied.

5.2 Surround panels

The surround panel acts as an idealized wall with high thermal resistance and holds the window or door in the correct position and separates the warm box from the cold box. The surround panel shall be large enough to cover the open face of the guard box in the case of a guarded hot-box apparatus or the open face of the hot box in the case of a calibrated hot-box apparatus.

The surround panel shall be not less than 100 mm thick or the maximum thickness of the specimen, whichever is the greater, and it shall be constructed with core material of stable thermal conductivity not greater than 0,04 W/(m·K). An appropriate aperture shall be provided to accommodate the calibration panel or test specimen (see Figures 1, 2, 3 and 4). Sealed plywood facing or plastic sheet on either side of the surround panel to provide rigidity is permitted. No material of thermal conductivity higher than 0,04 W/(m·K) (other than non-metallic thin tape) shall bridge the aperture. The surfaces of the surround panel and baffle plates shall have a high emissivity ($> 0,8$).

5.3 Test specimens

For general applications, specimen sizes may be typical of those found in practice. To ensure consistency of measurement, the specimen should be located as follows.

The window system shall fill the surround panel aperture. The internal frame face shall be as close to the face of the surround panel as possible, but no part shall project beyond the surround panel faces on either the cold or warm sides, except for handles, rails, fins or fittings which normally project (see Figure 1).

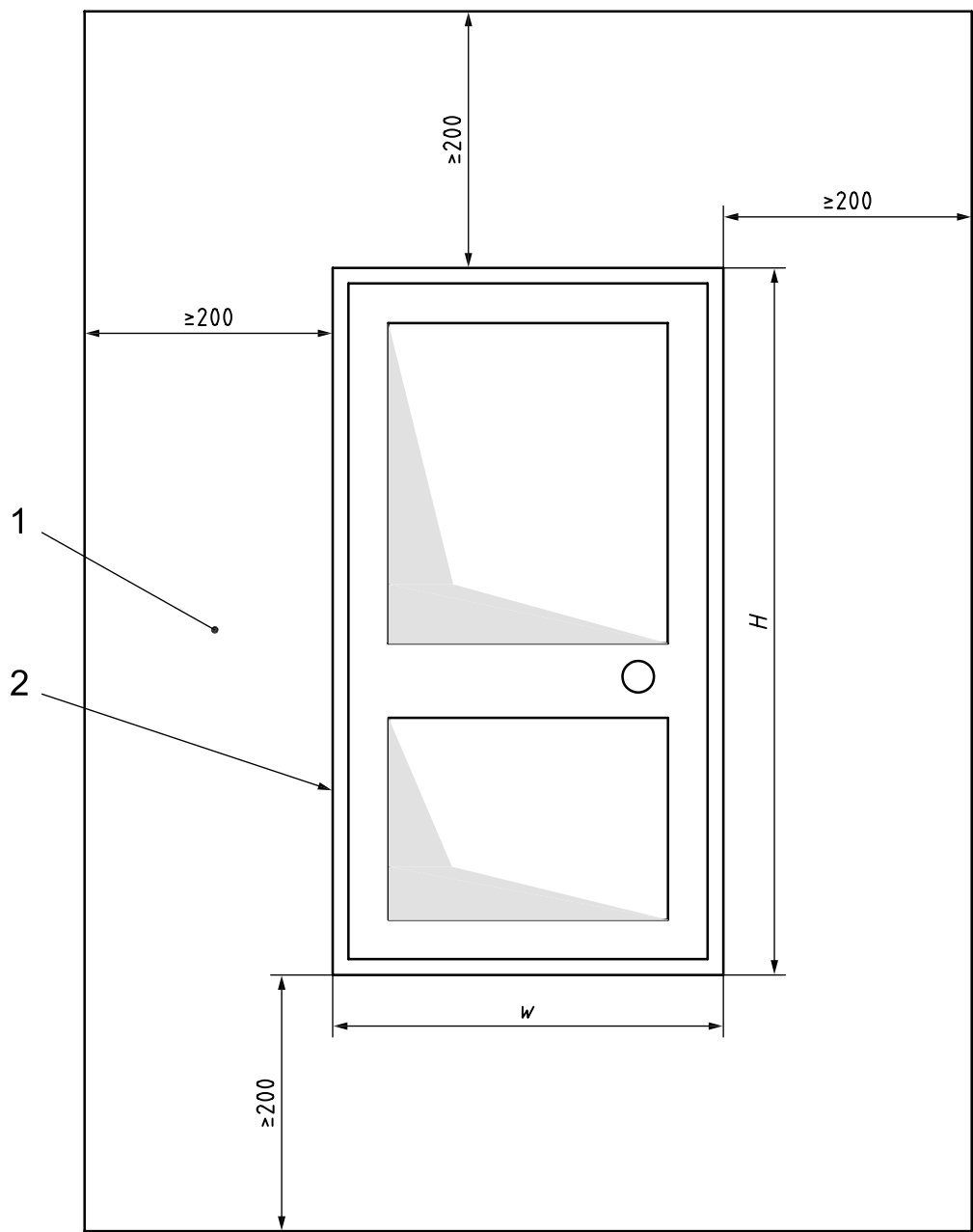
The door system may be mounted on either inside the surround panel (see Figures 2 and 4) or on the warm face (see Figure 3), according to the instructions and specifications given by the manufacturer.

It is recommended that the aperture be placed centrally in the surround panel and at least 200 mm from the inside surfaces of the cold and hot boxes, in order to avoid or limit edge heat flow corrections related to the perimeter of the surround panel (see Figure 6).

For standardized test applications, the overall sizes recommended are indicated in Table 4, or they shall conform to the size required by national standards or other regulations.

In any case, the area of aperture shall be not less than 0,8 m², for reasons of accuracy. The perimeter joints between the surround panel and the specimen shall be sealed on both sides with tape, caulking or mastic material.

Dimensions in millimetres



- Key**
- 1 surround panel
 - 2 test specimen

Figure 6 — Surround panel with test specimen

Table 4 — Recommended specimen sizes

Component	Height mm	Width mm
Window	1 480 (with a relative tolerance of – 25%)	1 230 (with a relative tolerance of $\pm$ 25%)
Window	2 180 (with a relative tolerance of $\pm$ 25%)	1 480 (with a relative tolerance of + 25%)
Door (leaf or doorset)	2 180 (with a relative tolerance of $\pm$ 25%)	1 230 (with a relative tolerance of $\pm$ 25%)
Door (leaf or doorset)	2 180 (with a relative tolerance of $\pm$ 25%)	2 000 (with a relative tolerance of $\pm$ 25%)

5.4 Calibration panels

Calibration panels shall be of a size similar to the test specimen (within $\pm 40\%$ in height and width of the test specimen). They are required to set up specified test conditions, to determine the surface coefficients of heat transfer and to establish the thermal resistance of the surround panel.

At least two calibration panels shall be built, which fulfil the following requirements.

- a) The core material of the calibration panel shall be made of homogeneous material with known thermal conductivity or thermal resistance. The material used shall not be prone to ageing effects.
- b) The nature of the surface of the calibration panel shall be similar to that of the test specimen. The emissivity of the surface shall be known (e.g. normal float glass) or shall be measured in accordance with EN 12898.
- c) The calibration panels shall cover the likely range of test specimen density of heat flow rate. The use of two calibration panels with different total thickness is recommended:
 - 1) total thickness approximately 20 mm;
 - 2) total thickness approximately 60 mm.

More details and guidance on how to build up the calibration panels are given in Annex C.

The thermal resistance of the insulating material used in the panels shall be measured for mean temperatures in the range $0\text{ }^{\circ}\text{C}$ to $15\text{ }^{\circ}\text{C}$, using a guarded hot plate or heat flow meter apparatus in accordance with ISO 8301 or ISO 8302, respectively. Alternatively, calibration panels may be used with certified properties from an accredited source. In any case, the calibration panels shall be mounted in the surround panel aperture 40 mm from the warm face as shown in Figure 3.

5.5 Temperature measurements and baffle positions

For calibration measurements, the warm and cold side surface temperatures shall be measured or calculated. (For calibration panel design and sensor mounting, see Annex C.) A minimum of nine positions at the centre of a rectangular grid of equal areas shall be used on the calibration panel and eight positions on the surround panel (Figure 5). No temperature sensors shall be closer than 100 mm to the edge of the calibration panel. Temperature sensors and recording systems shall be accurately calibrated. The recommended temperature sensor to be used for surface temperature measurement is the type T thermocouple (copper/constantan) in accordance with IEC 60584-1 made from wire with diameter not greater than 0,3 mm. They shall be fixed to the surface using adhesive or adhesive tape with an outer surface of high emissivity ($> 0,8$). If alternative sensors are used, they shall be at least as accurate as the above-mentioned, not subject to drift or hysteresis, and shall be as small as possible to avoid disturbance of the temperature field near the point of contact. Suitability can be investigated with an infrared camera under heat flow conditions similar to the required operating specifications. The uncertainty in the surface temperature measurements shall be experimentally determined.

It is recommended that the same layout of the surface temperature grid on the calibration panel be used (a minimum of nine) for air temperature and baffle plate measurements.

For natural convection on the warm side, the distance between the baffle and the plane of the warm face of the surround panel shall be not less than 150 mm and on the cold face not less than 100 mm for appropriate air speed (not less than 1,5 m/s during the first calibration test, see 5.6 and 6.2.2.1). Air temperatures shall be measured on each side outside the boundary layer (see Figure 7).

5.6 Air flow measurement

The cold side air speed shall be measured at a position that represents the free stream condition. For either vertical or horizontal flow patterns, it is essential that the sensor not be in the test specimen surface boundary layers or in the wake of any projecting fitting. If a small fan is used on the warm side, an air speed sensor (see Figure 7) shall be used to verify that the air speed representing natural convection prevails (less than 0,3 m/s).