INTERNATIONAL STANDARD

ISO 10077-1

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Thermal performance of windows, doors and shutters — Calculation of thermal transmittance —

Part 1: Simplified method

Performance thermique des fenêtres, portes et fermetures — Calcul du coefficient de transmission thermique

Partie 1: Méthode simplifiée

Reference number
ISO 10077-1:2000(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 3.

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 member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 10077 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10077-1 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 163, *Thermal insulation*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

ISO 10077 consists of the following parts, under the general title *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance*:

— *Part 1: Simplified method*

— *Part 2: Numerical method for frames*

Annex A forms a normative part of this part of ISO 10077. Annexes B to H are for information only. For the purposes of this part of ISO 10077, the CEN annex regarding fulfilment of European Council Directives has been removed.

Contents

Foreword

The text of EN ISO 10077-1:2000 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 January 2001, and conflicting national standards shall be withdrawn at the latest by January 2001.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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.

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

It contains two parts. Part 1 deals with the simplified calculation of the thermal transmittance of windows and doors with or without shutters. Part 2 covers the numerical calculation (two-dimensional) of the thermal transmittance of frame profiles.

Introduction

The method described in this standard is used to evaluate the thermal transmittance of windows and doors, or as part of the determination of the energy use of a building.

An alternative to this calculation method is testing according to EN ISO 12567 “Thermal performance of windows and doors – Determination of thermal transmittance by hot box methods”.

In some countries the calculation of the thermal transmittance of windows forms part of their national regulations. Information about national deviations from this standard due to regulations are given in annex ZA.

1 Scope

This standard specifies methods for the calculation of the thermal transmittance of windows and doors consisting of glazed or opaque panels fitted in a frame, with and without shutters.

It allows for:

- different types of glazing (glass or plastics; single or multiple glazing; with or without low emissivity coatings; with spaces filled with air or other gases);
- various types of frames (wood; plastic; metallic with and without thermal barrier; metallic with pinpoint metallic connections or any combination of materials);
- where appropriate, the additional thermal resistance introduced by different types of shutters, depending on their air permeability.

Curtain walls and other structural glazings, which are not fitted in a frame, are excluded from this standard. Roof windows are also excluded because of their complex geometrical frame sections.

Default values for glazings, frames and shutters are given in the informative annexes. Thermal bridge effects at the rebate or joint between the window or door frame and the rest of the building envelope are excluded from the calculation.

The calculation does not include:

– effects of solar radiation;
– heat transfer caused by air leakage;
– calculation of condensation;
– ventilation of air spaces in double and coupled windows.

2 Normative references

This 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 standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publications referred to applies.

EN 673	Glass in building – Determination of thermal transmittance (U value) – Calculation method
EN 674	Glass in building – Determination of thermal transmittance (U value) Guarded hot plate method
EN 675	Glass in building – Determination of thermal transmittance (U value) – Heat flow meter method
prEN 1098	Measuring method for the determination of the thermal transmittance of multiple glazing (U value) – Calibrated and guarded hot box method
prEN 1279-1	Glass in building - Insulating glass units - Part 1: Generalities and dimensional tolerances
prEN 1279-3	Glass in building - Insulating glass units - Part 3: Initial type testing on gas-filled insulating glass units: gas leakage rate
prEN 12412-2	Windows, doors and shutters - Determination of thermal transmittance by hot box method – Part 2: Frames
EN 12524	Building materials and products – Hygrothermal properties – Tabulated design values
EN ISO 6946	Building components and building elements – Thermal resistance and thermal transmittance – Calculation method (ISO 6946)
EN ISO 7345	Thermal insulation – Physical quantities and definitions (ISO 7345)
prEN ISO 10077-2	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO/DIS 10077-2)
EN ISO 10211-2	Thermal bridges in building construction - Calculation of heat flows and surface temperatures - Part 2: Linear thermal bridges (ISO 10211-2)
ISO 8302	Thermal insulation – Determination of steady-state thermal resistance and related properties – Guarded hot plate apparatus

3 Definitions, symbols and units

3.1 Definitions

For the purposes of this standard, the definitions given in EN 673 and EN ISO 7345 apply.

In clause 4 of this standard, descriptions are given of a number of geometrical characteristics of glazing and frame.

3.2 Symbols

Symbol	Quantity	Unit
A	area	m^2
R	thermal resistance	$m^2 \cdot K/W$
T	temperature	K
U	thermal transmittance	$W/(m^2 \cdot K)$
b	width	m
d	distance / thickness	m
l	length	m
q	density of heat flow rate	W/m^2
Ψ	linear thermal transmittance	W/(m·K)
λ	thermal conductivity	W/(m·K)

3.3 Subscripts

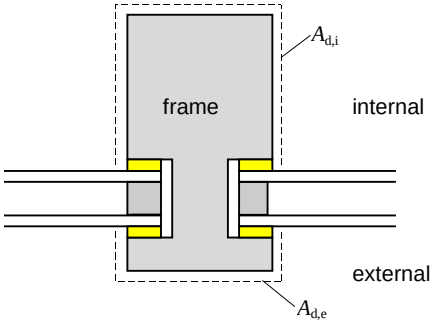


Figure 1 - Internal and external developed area

D	door		
W	window		
WS	window with closed shutter	*j*	summation index
d	developed	p	panel (opaque)
e	external	s	space (air or gas space)
f	frame	se	external surface
g	glazing	sh	shutter
i	internal	si	internal surface
sa	sash		

4 Geometrical characteristics

4.1 Glazed area, opaque panel area

The glazed area A_g or the opaque panel area A_p of a window or door is the smaller of the visible areas seen from both sides, see figure 2. Any overlapping of gaskets is ignored.

4.2 Total visible perimeter of the glazing

The total perimeter of the glazing l_g (or the opaque panel l_p) is the sum of the visible perimeter of the glass panes (or opaque panels) in the window or door. If the perimeters are different on either side of the pane or panel then the larger of the two shall be used, see figure 2.

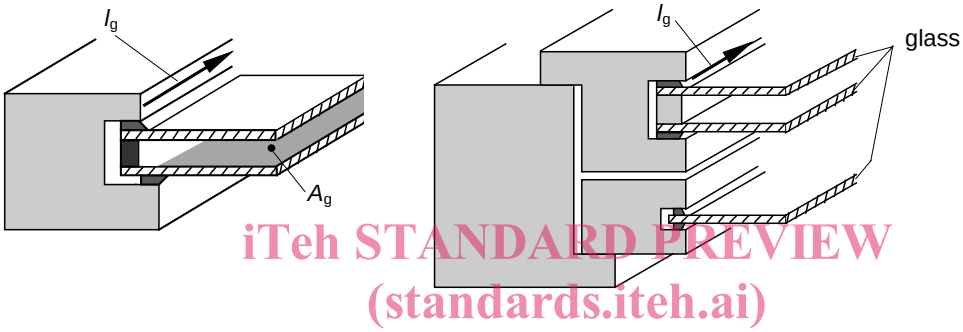


Figure 2 - Illustration of glazed area and perimeter

4.3 Frame areas

For the definition of the areas see also figure 3.

$A_{f,i}$ Internal projected frame area
The internal projected frame area is the area of the projection of the internal frame on a plane parallel to the glazing panel.

$A_{f,e}$ External projected frame area
The external projected frame area is the area of the projection of the external frame on a plane parallel to the glazing panel.

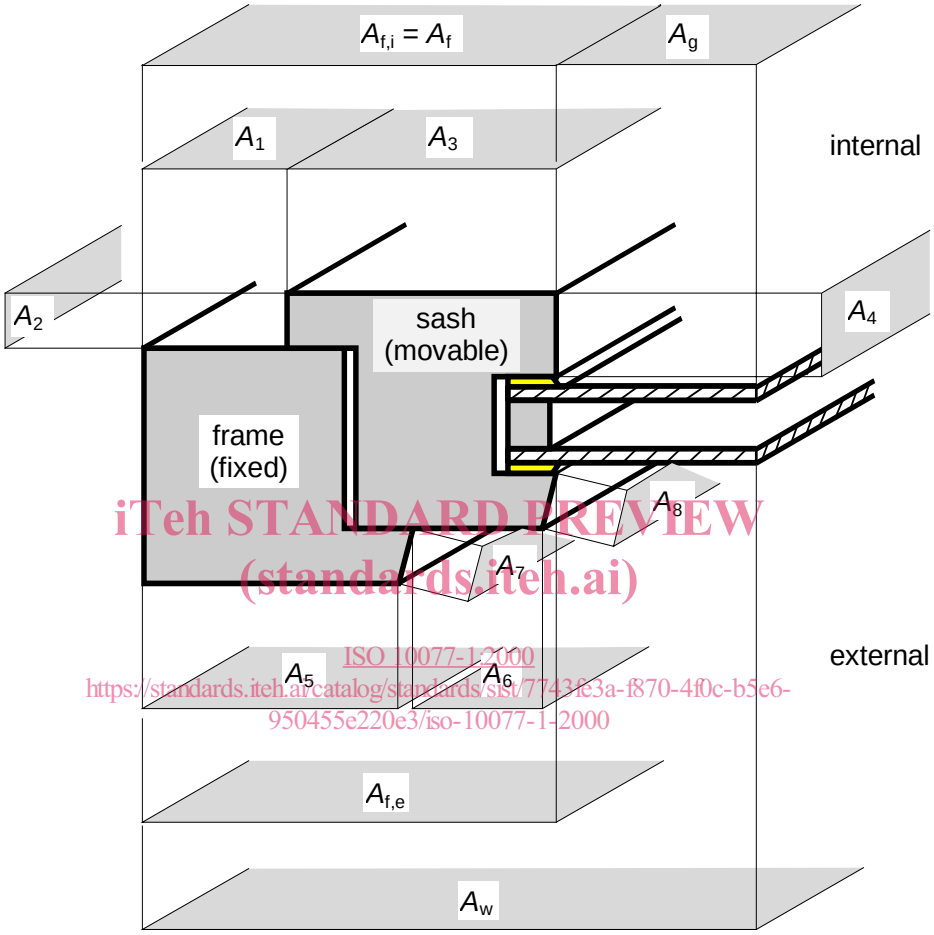
A_f Frame area
The frame area is the larger of the two projected areas seen from both sides.

$A_{d,i}$ Internal developed frame area
The internal developed frame area is the area of the frame in contact with the internal air (see figure 1).

$A_{d,e}$ External developed frame area
The external developed frame area is the area of the frame in contact with the external air (see figure 1).

4.4 Window area

The window area A_w is the sum of the frame area A_f and the glazing area A_g (or the panel area A_p).



NOTE $A_f = \max(A_{f,i}; A_{f,e})$
$A_w = A_f + A_g$
$A_{d,i} = A_1 + A_2 + A_3 + A_4$
$A_{d,e} = A_5 + A_6 + A_7 + A_8$

Figure 3 - Illustration of the various areas

5 Calculation of thermal transmittance

5.1 Windows

5.1.1 Single windows

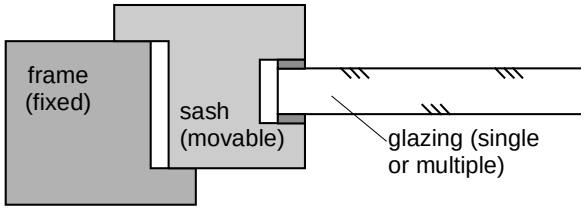


Figure 4 - Illustration of single window

The thermal transmittance of a single window U_W shall be calculated using equation (1):

$$U_W = \frac{A_g U_g + A_f U_f + l_g \Psi_g}{A_g + A_f} \quad (1)$$

where

U_g is the thermal transmittance of the glazing;

U_f is the thermal transmittance of the frame;

Ψ_g is the linear thermal transmittance due to the combined thermal effects of glazing, spacer and frame;

and the other symbols are defined in clause 4.

In the case of single glazing the last term of the numerator in equation (1) shall be taken as zero (no spacer effect) because any correction is negligible.

When opaque panels are used instead of some of the glazing, U_W is calculated as follows:

$$U_W = \frac{A_g U_g + A_p U_p + A_f U_f + l_g \Psi_g + l_p \Psi_p}{A_g + A_p + A_f} \quad (2)$$

where

U_p is the thermal transmittance of the opaque panel(s);

Ψ_p is the linear thermal transmittance for the opaque panel(s).

If the opaque panel is thermally bridged at the edge by a less insulating spacer, the effect of the bridging shall be taken into account in the same way as for glazing; otherwise $\Psi_p = 0$.

NOTE Typical values of the linear thermal transmittance are given in annex E.
prEN ISO 10077-2 gives a method for calculating linear thermal transmittance.
prEN 12412-2 gives a method for measuring the linear thermal transmittance.