SLOVENSKI STANDARD

oSIST prEN ISO 10077-2:2015

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Toplotne lastnosti oken, vrat in polken - Izračun toplotne prehodnosti - 2. del: Računska metoda za okvirje (ISO/DIS 10077-2:2015)

Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO/DIS 10077-2:2015)

Wärmetechnisches Verhalten von Fenstern, Türen und Abschlüssen - Berechnung des Wärmedurchgangskoeffizienten - Teil 2: Numerisches Verfahren für Rahmen (ISO/DIS 10077-2:2015)

Performance thermique des fenêtres, portes et fermetures - Calcul du coefficient de transmission thermique - Partie 2 : Méthode numérique pour les encadrementes (ISO/DIS 10077-2:2015)

Ta slovenski standard je istoveten z: **prEN ISO 10077-2**

ICS:

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

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DRAFT INTERNATIONAL STANDARD

ISO/DIS 10077-2

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

Part 2: Numerical method for frames

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

Partie 2: Méthode numérique pour les encadrements

ICS: 91.060.50; 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.

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Contents

Page

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 10077-2 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, and by Technical Committee CEN/TC 89, *Thermal performance of buildings and building components* in collaboration.

This third edition cancels and replaces the second edition (ISO 10077-2:2012), clause 6, annex C and D have been technically revised and a new annex D is introduced. The necessary editorial revisions were made to comply with the requirements for the EPB set of standards.

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

— *Part 1: General*

— *Part 2: Numerical method for frames*

Introduction

This Standard is part of a series of standards aiming at international harmonisation of the methodology for the assessment of the energy performance of buildings, called "EPB set of standards".

As part of the "EPB set of standards" it complies with the requirements for the set of basic EPB documents (EN 15603 (see Normative references), CEN/TS 16628 and CEN/TS 16629 (see bibliography [1] and [2]) developed under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480), and supports essential requirements of EU Directive 2010/31/EC on the energy performance of buildings (EPBD).

Where appropriate, the method(s) in each of the EPB standards may provide simplified procedures and/or default values as alternative options.

— Without further specification, these simplified procedures and/or default values may be used without restricting criteria.

NOTE 1 For instance because these are conservative procedures or values.

NOTE 2 The term 'default values' should not be confused with 'informative values'. If the values are given in the normative part of the standard, they are normative values. See also next options.

— In other cases, these simplified procedures and/or default values may be intended to be used only for situations where there is limited information. This may be the case in existing buildings with limited possibilities to acquire all input data. In particular when the EPB set of standards is used in the context of national or regional building regulations, specific criteria when the simplified method and/or default data are allowed, may be given at national or regional level, following the template in Annex A. Annex B provides (informative) default choices.

The set of EPB standards prepared under the responsibility of ISO/TC 163/SC 2 (Thermal performance and energy use in the built environment, Calculation methods) in collaboration with CEN/TC 89 range from calculation procedures on the overall energy use and energy performance of buildings, calculation procedures on the indoor temperature in buildings (e.g. in case of no space heating or cooling) and calculation methods covering the performance and thermal, hygrothermal, solar and visual characteristics of specific parts of the building and specific building elements and components, such as opaque envelope elements, ground floor, windows and facades. ISO/TC 163/SC 2 cooperates with other TC's for the details on e.g. appliances, technical building systems and indoor environment.

ISO 10077 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance consists of two parts. The method in Part 2 Numerical method for frames is intended to provide calculated values of the thermal characteristics of frame profiles, suitable to be used as input data in the calculation method of the thermal transmittance of windows, doors and shutters given in Part 1 "General". It is an alternative to the test method specified in EN 12412–2 (see Bibliography). In some cases, the hot box method can be preferred, especially if physical and geometrical data are not available or if the profile is of complicated geometrical shape.

Although the method in this Part 2 basically applies to vertical frame profiles, it is an acceptable approximation for horizontal frame profiles (e.g. sill and head sections) and for products used in sloped positions (e.g. roof windows). For calculations made with the glazing units in place, the heat flow pattern and the temperature field within the frame are useful by-products of this calculation.

The standard does not cover building facades and curtain walling, for which see ISO 12631, *Thermal performance of curtain walling – Calculation of thermal transmittance* or ISO 12631, *Thermal performance of curtain walling – Calculation of thermal transmittance.*

Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 2: Numerical method for frames

1 Scope

This International Standard specifies a method and gives reference input data for the calculation of the thermal transmittance of frame profiles and of the linear thermal transmittance of their junction with glazing or opaque panels.

The method can also be used to evaluate the thermal resistance of shutter profiles and the thermal characteristics of roller shutter boxes and similar components (e.g. blinds).

This standard also gives criteria for the validation of numerical methods used for the calculation.

This standard does not include effects of solar radiation, heat transfer caused by air leakage or three-dimensional heat transfer such as pin point metallic connections. Thermal bridge effects between the frame and the building structure are not included.

Table 1 shows the relative position of this standard within the EPB package of standards.

Table 1 —Position of this International Standard within the modular EPB set of standards [a]

	Over-arching	Building (as such)	Technical Building Systems									
Submodule	Descriptions	Descriptions	Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation & control	PV, wind, ..
sub1	M1	M2		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General	General	General									
2	Common terms and definitions; symbols, units and subscripts	Building Energy Needs	Needs								N.A.	N.A.
3	Applications	(Free) Indoor Conditions without Systems	Maximum Load and Power								N.A.	N.A.
4	Ways to Express Energy Performance	**Ways to Express Energy Performance**	Ways to Express Energy Performance									
5	Building Functions and Building Boundaries	Heat Transfer by Transmission[a]	Emission & control									N.A.
6	Building Occupancy and Operating Conditions	Heat Transfer by Infiltration and Ventilation	Distribution & control									
7	Aggregation of Energy Services and Energy Carriers	Internal Heat Gains	Storage & control				N.A.	N.A.		N.A.		
8	Building Partitioning	Solar Heat Gains	Generation & control									
9	Calculated Energy Performance	Building Dynamics (thermal mass)	Load dispatching and operating conditions				N.A.	N.A.		N.A.		N.A.
10	Measured Energy Performance	Measured Energy Performance	Measured Energy Performance									
11	Inspection	Inspection	Inspection									
12	Ways to Express Indoor Comfort	N.A.	BMS	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.		N.A.
13	External Environment Conditions	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
14	Economic Calculation	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

a Position of this International Standard: M2-5.

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 6946, *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

ISO 7345, *Thermal insulation — Physical quantities and definitions*

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

ISO 10456, *Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values*

ISO 12567-2:2005, *Thermal performance of windows and doors — Determination of thermal transmittance by hot box method — Part 2: Roof windows and other projecting windows*

ISO 17025, *General requirements for the competence of testing and calibration laboratories*

EN 673, *Glass in building — Calculation of thermal transmittance (U-value) — Calculation Method*

EN 12519, *Windows and pedestrian doors — Terminology*

ISO 10292, *Glass in building — Calculation of steady-state U values (thermal transmittance) of multiple glazing*

FprEN 15603:2014, *Energy performance of buildings — Overarching standard EPB*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in ISO 7345 and EN 12519 apply.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this Standard, the symbols given in prEN 15603:2013 and the specific symbols listed in Table 2 apply

Table 2 — Symbols and units

Symbol	Name of quantity	Unit
A	area	m^2
b	width, i.e. perpendicular to the direction of heat flow	m
d	depth, i.e. parallel to the direction of heat flow	m
C	constant in formula for Nusselt number	$W/(m^2 \cdot K^{4/3})$

Symbol	Name of quantity	Unit
E	intersurface emittance	–
F	view factor	–
h	heat transfer coefficient	$W/(m^2 \cdot K)$
L^{2D}	two-dimensional thermal conductance or thermal coupling coefficient	W/(m·K)
l	length	m
Nu	Nusselt number	–
q	density of heat flow rate	W/m^2
R	thermal resistance	$m^2 \cdot K/W$
T	thermodynamic temperature	K
U	thermal transmittance	$W/(m^2 \cdot K)$
σ	Stefan-Boltzmann constant	$W/(m^2 \cdot K^4)$
ε	emissivity	–
λ	thermal conductivity	W/(m·K)
Ψ	linear thermal transmittance	W/(m·K)

4.2 Subscripts

For the purposes of this standard, the subscripts given in prEN 15603:2013 and the specific subscripts listed in Table 3 apply.

Table 3 — Subscripts

a	convective (surface to surface)	m	mean
e	external (outdoor)	p	panel
g	glazing	r	radiative
eq	equivalent	s	space (air or gas space)
f	frame	sb	shutter box
fr	frame adjacent to roller shutter box	se	external surface
i	internal (indoor)	si	internal surface

5 Calculation method

5.1 Output of the method

The possible outputs of this standard are the following:

— The thermal transmittance of a frame profile, U_f;

— The thermal transmittance of a shutter box, U_{sb};

— The linear thermal transmittance of a the junction of a frame profile with a glazing or opaque panel, Ψ.

5.2 General principle

The calculation is carried out using a two-dimensional numerical method conforming to ISO 10211. The elements shall be divided such that any further division does not change the calculated result significantly. ISO 10211 gives criteria for judging whether sufficient sub-divisions have been used.

Vertical orientation of frame sections and air cavities is assumed for calculations by this standard for the purposes of assigning equivalent thermal conductivity values (see 6.4.2.3); this applies irrespective of the intended orientation of the actual window, including roof windows.

5.3 Validation of the calculation programs

To ensure the suitability of the calculation program used, calculations shall be carried out on the examples described in Annexes G and H.

The requirements for all validation cases in Annexes G and H shall be fulfilled.

The calculated two-dimensional thermal conductance L^{2D} for the cases in Annex H shall not differ from the corresponding values given in Tables H.3 and H.4 by more than ±3 %. This will lead to an accuracy of the thermal transmittance, U, and the linear thermal transmittance Ψ, of about 5 %.

6 Calculation of thermal transmittance

6.1 Output data

The outputs of this standard are transmission heat transfer coefficients.

Table 4 — Output data

Description	Symbol	Unit	Destination module	Validity interval	Varying
Thermal transmittance of frame profile	U_f	W/(m^2 K)	M2-5	0…∞	NO
Thermal transmittance of shutter box	U_{sb}	W/(m^2 K)	M2-5	0…∞	NO
Linear thermal transmittance	Ψ	W/(m K)	M2-5	0…∞	NO

6.2 Calculation time steps

The calculations described in this standard are steady-state and do not have time steps.

6.3 Input data

6.3.1 Geometrical characteristics

Table 5 – Identifiers for geometric characteristics

Name	Symbol	Unit	Range	Origin	Varying
Geometrical data					
Cross section of the frame profile				Manufacturer	NO
Cross section of the shutter box				Manufacturer	NO
Cross section of the junction frame profile and glazing				Manufacturer	NO
Cross section of the junction frame profile and panel				Manufacturer	NO

For frames with special extensions overlapping the wall or other building elements, such as a Z-shaped profiles, the extensions shall be disregarded as illustrated in Figure 1. This applies to all profiles with special extensions (e.g. H-shape) where the extensions overlap the wall or other building elements. Other boundaries shall be treated as defined in Figure 2.

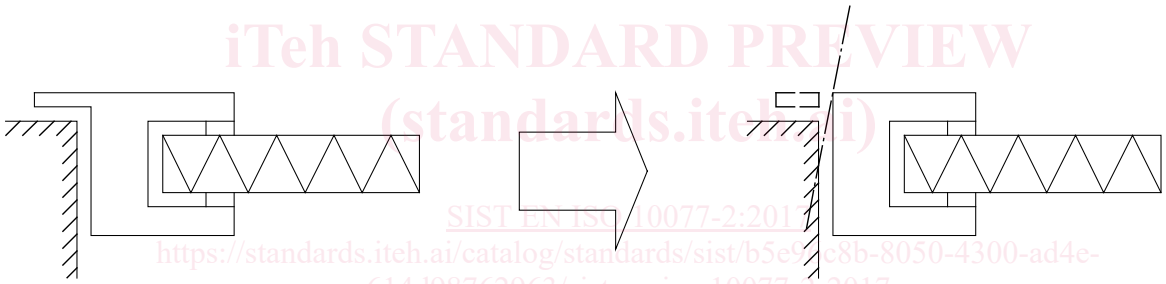

Figure 1 — Treatment of profiles with extensions (Z-shape)

NOTE 1 This approximation is for assessment of thermal transmittance. It is not appropriate for assessment of condensation risk.

NOTE 2 The extension of the frame profile is disregarded in the calculation of the thermal transmittance of the window (see ISO 10077-1).

6.3.2 Thermal conductivity values

For the purpose of this standard, thermal conductivity values used for solid materials shall be obtained according to one of the following:

— Table D.1 of this standard;

— tabulated values given in ISO 10456;

— product standards;

— technical approvals by a recognized national body;

— measurements according to an appropriate international standard.

Measurements shall be used only if there is no tabulated data or data according to relevant product standards or a technical approval. Measurements shall be performed at a mean temperature of 10 °C using the appropriate method by an institute accredited (as specified in ISO 17025) to carry out those measurements, on samples that have been conditioned at 23 °C and 50% RH to constant mass (change in mass not more than 0,1 % over 24 h). To ensure that the thermal conductivity values are representative of the material (that is, that the value incorporates likely variability of the material and the measurement uncertainty), one of the following methods shall be used for obtaining the thermal conductivity value from measured data used in the calculations:

— The thermal conductivity is the declared value obtained from the measured data (at least three different samples from different lots representing the usual product variation, with ageing taken into consideration) according to a statistical evaluation as defined in ISO 10456 Annex C, 90 % fractile;

— If less than three samples, use the mean value multiplied by a factor of 1,25.

6.3.3 Emissivity of surfaces

Normally the emissivity of surfaces bounding an air cavity shall have an emissivity of 0,9. Metallic surfaces such as aluminium alloy frame, steel reinforcement and other metals/alloys have lower emissivity. Typical values of the emissivity for metallic surfaces are given in Table D.3. Values less than 0,9 may be used only if taken from Table A.3 or measured in accordance with an appropriate standard by an institute accredited (as specified in ISO 17025) to carry out those measurements. Where based on measured values there shall be at least three samples and the results shall be evaluated according to the statistical treatment in ISO 10456.

In this standard, it is assumed that the total hemispherical emissivity is equal to the normal emissivity.

6.3.4 General Boundaries

The external and internal surface resistances depend on the convective and radiative heat transfer to the external and internal environments. If an external surface is not exposed to normal wind conditions the convective part may be reduced in edges or junctions between two surfaces. The surface resistances for horizontal heat flow are given in Annex E. These values shall be used for calculations by this standard irrespective of the intended orientation of the actual window, including roof windows. Surface condensation shall be assessed on the basis of the lowest internal surface temperature calculated using the surface resistances in Annex B.

The cutting plane of the infill and the cutting plane to neighbouring material shall be taken as adiabatic (see Figure 3 and Annex H)

The reference temperature conditions shall be 20 °C internal and 0 °C external.

6.3.5 Boundaries for roller shutter boxes

Calculation of the thermal transmittance of a roller shutter box shall be done with the following boundary conditions:

— the top of the roller shutter box: adiabatic;

— at the bottom of the roller shutter box where it adjoins the window frame: adiabatic for a distance of 60 mm;

— surfaces adjacent to the internal environment: surface resistance of 0,13 $m^2 \cdot K/W$;

— surfaces adjacent to the external environment: surface resistance of 0,04 $m^2 \cdot K/W$.