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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

Reference number
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 10077-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 89*, Thermal performance of buildings and building components*, in collaboration with ISO Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 10077-2:2012), which has been technically revised to comply with the requirements for the EPB set of standards. It also incorporates the Technical Corrigendum ISO 10077-2:2012/Cor 1:2012.

In addition, Clause 6 has been technically revised by

— adding a new approach for the treatment of cavities,

— separating conduction/convection and radiation, and

— introducing the radiosity method.

Annex H and Annex G were also added.

A list of all parts in the ISO 10077 series can be found on the ISO website.

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Introduction

This document is part of a series aimed at the international harmonization of the methodology for assessing the energy performance of buildings. Throughout, this series is referred to as a "set of EPB standards".

All EPB standards follow specific rules to ensure overall consistency, unambiguity and transparency.

All EPB standards provide a certain flexibility with regard to the methods, the required input data and references to other EPB standards, by the introduction of a normative template in Annex A and Annex B with informative default choices.

For the correct use of this document, a normative template is given in Annex A to specify these choices. Informative default choices are provided in Annex B.

The main target groups for this document are architects, engineers and regulators.

Use by or for regulators: In case ISO 52000-1 is used in the context of national or regional legal requirements, mandatory choices may be given at national or regional level for such specific applications. These choices (either the informative default choices from Annex B or choices adapted to national/regional needs, but in any case following the template of this Annex A) can be made available as national annex or as separate (e.g. legal) document (national data sheet).

NOTE 1 So in this case:

— the regulators will **specify** the choices;

— the individual user will apply the document to assess the energy performance of a building, and thereby **use** the choices made by the regulators

Topics addressed in this document can be subject to public regulation. Public regulation on the same topics can override the default values in Annex B of this document. Public regulation on the same topics can even, for certain applications, override the use of this document. Legal requirements and choices are in general not published in standards but in legal documents. In order to avoid double publications and difficult updating of double documents, a national annex may refer to the legal texts where national choices have been made by public authorities. Different national annexes or national data sheets are possible, for different applications.

It is expected, if the default values, choices and references to other EPB standards in Annex B are not followed due to national regulations, policy or traditions, that:

— national or regional authorities prepare data sheets containing the choices and national or regional values, according to the model in Annex A. In this case a national annex (e.g. NA) is recommended, containing a reference to these data sheets;;

— or, by default, the national standards body will consider the possibility to add or include a national annex in agreement with the template of Annex A, in accordance to the legal documents that give national or regional values and choices.

Further target groups are parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

More information is provided in the Technical Report (ISO/TR 52022-2) accompanying this document.

The framework for overall EPB includes:

a) common terms, definitions and symbols;

b) building and assessment boundaries;

c) building partitioning into space categories;

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d) methodology for calculating the EPB (formulae on energy used, delivered, produced and/or exported at the building site and nearby);

e) a set of overall formulae and input-output relations, linking the various elements relevant for the assessment of the overall EPB;

f) general requirements for EPB dealing with partial calculations;

g) rules for the combination of different spaces into zones;

h) performance indicators;

i) methodology for measured energy performance assessment.

ISO 10077 consists of two parts. This document is intended to provide calculated values of the thermal characteristics of frame profiles, suitable for use as input data in the calculation method of the thermal transmittance of windows, doors and shutters given in ISO 10077-1. It is an alternative to the hot box test method specified in EN 12412–2. 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 document 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 ISO 10077 series does not cover building facades and curtain walling, which are covered in ISO 12631.

Table 1 shows the relative position of this document within the set of EPB standards in the context of the modular structure as set out in ISO 52000-1.

NOTE 2 In ISO/TR 52000-2, the same table can be found, with, for each module, the numbers of the relevant EPB standards and accompanying technical reports that are published or in preparation.

NOTE 3 The modules represent EPB standards, although one EPB standard could cover more than one module and one module could be covered by more than one EPB standard, for instance, a simplified and a detailed method respectively.

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Table 1 — Position of this document (*in casu* M2–5), within the modular structure of the set of EPB standards

	Overarching		Building (as such)		Technical building systems									
Sub module	**Descriptions**		**Descriptions**		**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidification**	**Dehumidification**	**Domestic hot water**	**Lighting**	**Building automation and 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								[a]	
3	Applications		(Free) Indoor conditions without systems		Maximum load and power									
4	Ways to express energy performance		Ways to express energy performance		Ways to express energy performance									
5	Building categories and building boundaries		Heat transfer by transmission	ISO 10077-2	Emission and control									
6	Building occupancy operating conditions		Heat transfer by infiltration and ventilation		Distribution and control									
7	Aggregation of energy services and energy carriers		Internal heat gains		Storage and control									
8	Building zoning		Solar heat gains		Generation and control									
9	Calculated energy performance		Building dynamics (thermal mass)		Load dispatching and operating conditions									

[a] The shaded modules are not applicable.

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Table 1 *(continued)*

	Overarching		Building (as such)		Technical building systems									
Sub module	**Descriptions**		**Descriptions**		**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidification**	**Dehumidification**	**Domestic hot water**	**Lighting**	**Building automation and control**	**PV, wind, ..**
sub1		**M1**		**M2**		**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
10	Measured energy performance		Measured energy performance		Measured energy performance									
11	Inspection		Inspection		Inspection									
12	Ways to express indoor comfort				BMS									
13	External environment conditions													
14	Economic calculation													

[a] The shaded modules are not applicable.

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

Part 2: Numerical method for frames

1 Scope

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

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

NOTE Table 1 in the Introduction shows the relative position of this document within the set of EPB standards in the context of the modular structure as set out in ISO 52000-1.

2 Normative references

The following documents are referred to in text in such a way that some or all of their content constitutes requirements 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 10211, *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*

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

ISO 10456:2007, *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*

ISO 52000-1, *Energy performance of buildings — Overarching EPB assessment —– Part 1: General framework and procedures*

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

EN 12519, *Windows and pedestrian doors — Terminology*

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NOTE Default references to EPB standards other than ISO 52000-1 are identified by the EPB module code number and given in Annex A (normative template in Table A.1) and Annex B (informative default choice in Table B.1).

EXAMPLE EPB module code number: M5–5, or M5–5.1 (if module M5–5 is subdivided), or M5–5/1 (if reference to a specific clause of the standard covering M5–5).

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, EN 12519, ISO 52000-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
EPB standard
standard that complies with the requirements given in ISO 52000-1, CEN/TS 16628[10] and CEN/TS 16629[11]

Note 1 to entry: These three basic EPB documents were developed under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480), and support essential requirements of EU Directive 2010/31/EU on the energy performance of buildings (EPBD). Several EPB standards and related documents are developed or revised under the same mandate.

[SOURCE: ISO 52000-1:2017, definition 3.5.14]

4 Symbols and subscripts

4.1 Symbols

For the purposes of this document, the symbols given in ISO 52000-1 and the following apply.

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	$W/(m^2 \cdot K^{4/3})$
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	$W/(m \cdot K)$
l	length	m
Nu	Nusselt number	—
q	density of heat flow rate	W/m^2
R	thermal resistance	$m^2 \cdot K/W$
r	distance	m
T	thermodynamic temperature	K
U	thermal transmittance	$W/(m^2 \cdot K)$
σ	Stefan-Boltzmann constant	$W/(m^2 \cdot K^4)$

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