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

**Part 1:
General**

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

Partie 1: Généralités





COPYRIGHT PROTECTED DOCUMENT

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	iv
Introduction	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions	3
4 Symbols and subscripts	3
4.1 Symbols.....	3
4.2 Subscripts.....	4
5 Description of the method	4
5.1 Output of the method.....	4
5.2 General description.....	4
5.3 Other general topics.....	5
6 Calculation of thermal transmittance	5
6.1 Output data.....	5
6.2 Calculation time intervals.....	5
6.3 Input data.....	5
6.3.1 Geometrical characteristics.....	5
6.3.2 Thermal characteristics.....	8
6.4 Calculation procedure.....	11
6.4.1 Applicable time interval.....	11
6.4.2 Calculation of thermal transmittance.....	11
7 Test report	17
7.1 Contents of test report.....	17
7.2 Drawing of sections.....	18
7.2.1 Drawing of the whole window or door.....	18
7.2.2 Values used in the calculation.....	18
7.2.3 Presentation of results.....	18
Annex A (normative) Input and method selection data sheet — Template	19
Annex B (informative) Input and method selection data sheet — Default choices	21
Annex C (normative) Regional references in line with ISO Global Relevance Policy	23
Annex D (normative) Internal and external surface thermal resistances	24
Annex E (normative) Thermal resistance of air spaces between glazing and thermal transmittance of coupled, double or triple glazing	25
Annex F (normative) Thermal transmittance of frames	26
Annex G (normative) Linear thermal transmittance of frame/glazing junction and glazing bars	32
Annex H (normative) Thermal transmittance of windows	36
Bibliography	41

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 10077-1 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 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 10077-1:2006), of which it constitutes a minor revision. The necessary editorial revisions were made to comply with the requirements for the EPB set of standards.

In addition, the following clauses and subclauses of the previous version have been revised.

- In Clause 6 (previous edition), the boundary condition “determined with the glazing replaced with a material of thermal conductivity not exceeding 0,04 W/(m²·K)” was deleted, because the rules are defined in EN 12412-2.
- In Clause 6 (previous edition), the measurement according to EN 12412-2 for the determination of Ψ_g and/or Ψ_p was deleted. It is not within the scope of EN 12412-2 to determine Ψ values.
- In Clause 6 (previous edition), the second paragraph was deleted. It is not necessary to give further possibilities. Determination of the input data in unambiguous is defined.
- In 5.2.2 (previous edition), the formula was deleted. Determination of U_g is according to ISO 10292.¹⁾
- Formulae (1) and (2) were extended for the consideration of glazing bars.
- Tabulated values were added for the linear thermal transmittance of glazing bars.
- Status of Annex C (previous edition) was changed to normative; some values were revised to give the values to two significant figures.

1) See [Table C.1](#) for alternative regional references in line with ISO Global Relevance Policy.

- Table C.2 (previous edition) was moved to ISO/TR 52022-2:2017.
- Annex E (previous edition) was moved to the main body of the document.
- Annex G and Annex H (previous edition) were moved to ISO/TR 52022-2:2017.

It also incorporates the Technical Corrigendum ISO 10077-1:2006/Cor. 1:2009.

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

Introduction

This document is part of a series of standards aiming at international harmonization of the methodology for the assessment of the energy performance of buildings, called “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 of this document are manufacturers of windows.

Use by or for regulators: In case the document 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 in [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 standard 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](#). 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 in [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 accompanying this document (ISO/TR 52022-2).

The calculation method described in this document 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 calculation is testing of the complete window or door according to ISO 12567-1 or, for roof windows, according to ISO 12567-2.

The calculation is based on four component parts of the overall thermal transmittance:

- for elements containing glazing, the thermal transmittance of the glazing, calculated using EN 673 or measured according to EN 674 or EN 675;
- for elements containing opaque panels, the thermal transmittance of the opaque panels, calculated according to ISO 6946 and/or ISO 10211 (all parts) or measured according to ISO 8301 or ISO 8302;
- thermal transmittance of the frame, calculated using ISO 10077-2, measured according to EN 12412-2, or taken from [Annex D](#);
- linear thermal transmittance of the frame/glazing junction, calculated according to ISO 10077-2 or taken from [Annex E](#).

The thermal transmittance of curtain walling can be calculated using ISO 12631.

EN 13241-1 gives procedures applicable to doors intended to provide access for goods and vehicles.

[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.

Table 1 — Position of this document (in case 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 10077-1	Emission and control									
a The shaded modules are not applicable.														

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
6	Building occupancy and 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									
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.														

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

Part 1: General

1 Scope

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

This document allows for

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

The thermal transmittance of roof windows and other projecting windows can be calculated according to this document, provided that the thermal transmittance of their frame sections is determined by measurement or by numerical calculation.

Default values for glazing, frames and shutters are given in the 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 (see standards under M2-8),
- heat transfer caused by air leakage (see standards under M2-6),
- calculation of condensation,
- ventilation of air spaces in double and coupled windows, and
- surrounding parts of an oriel window.

The document is not applicable to

- curtain walls and other structural glazing (see other standards under M2-5), and
- industrial, commercial and garage doors.

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.