INTERNATIONAL STANDARD

ISO 52022-3

First edition
2017-06

Energy performance of buildings — Thermal, solar and daylight properties of building components and elements —

Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing

Performance énergétique des bâtiments — Propriétés thermiques, solaires et lumineuses des composants et éléments du bâtiment —

Partie 3: Méthode de calcul détaillée des caractéristiques solaires et en lumière du jour pour les dispositifs de protection solaire combinés à des vitrages

Reference number
ISO 52022-3:2017(E)

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

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 52022-3 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).

A list of parts in the ISO 52022 series can be found on the ISO website.

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 this 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 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 accompanying this document (ISO/TR 52022-2).

The framework for overall EPB includes:

a) common terms, definitions and symbols;

b) building and assessment boundaries;

c) building partitioning into space categories;

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.

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. See also Tables A.1 and B.1.

Table 1 — Position of this document (in casu M2-8) 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		Emission and control									
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									

[a] The shaded modules are not applicable.

Table 1 *(continued)*

	Overarching		Building (as such)		Technical Building Systems									
Sub-module	**Descrip-tions**		**Descrip-tions**		**Descrip-tions**	**Heat-ing**	**Cool-ing**	**Ven-tila-tion**	**Humid-ification**	**Dehu-midifi-cation**	**Domestic hot water**	**Lighting**	**Building automa-tion and control**	**PV, wind, ..**
sub1		**M1**		**M2**		**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
8	Building zoning		Solar heat gains	ISO 520 22 -3	Generation and control									
9	Calculated energy per-formance		Building dynamics (thermal mass)		Load dis-patching and operating conditions									
10	Measured energy per-formance		Measured energy per-formance		Measured energy per-formance									
11	Inspection		Inspection		Inspection									
12	Ways to ex-press indoor comfort				BMS									
13	External environment conditions													
14	Economic calculation													

[a] The shaded modules are not applicable.

Energy performance of buildings — Thermal, solar and daylight properties of building components and elements —

Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing

1 Scope

This document specifies a detailed method, based on spectral data of the transmittance and reflectance of the constituent materials (solar protection devices and the glazing), to determine the total solar energy transmittance, the total light transmittance and other relevant solar-optical data of the combination. If spectral data are not available, the methodology can be adapted to use integrated data.

The method is valid for all types of solar protection devices parallel to the glazing such as louvres, venetian blinds, or roller blinds. The blind may be located internally, externally, or enclosed between the panes of the glazing. Ventilation of the blind is allowed for in each of these positions in determining the solar energy absorbed by the glazing or blind components, for vertical orientation of the glazing.

The blind component materials may be transparent, translucent or opaque, combined with glazing components with known solar transmittance and reflectance and with known emissivity for thermal radiation.

The method is based on a normal incidence of radiation and does not take into account an angular dependence of transmittance or reflectance of the materials. Diffuse irradiation or radiation diffused by solar protection devices is treated as if it were direct. Louvres or venetian blinds are treated as homogenous materials by equivalent solar optical characteristics, which may depend on the angle of the incidence radiation. The current method is limited to vertical installation ±15°. For situations outside the scope of this document; ISO 15099 covers a wider range of situations.

The document also gives certain normalized situations, additional assumptions and necessary boundary conditions.

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

ISO 9488, *Solar energy — Vocabulary*

ISO 9050, *Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors*

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

ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures*

EN 410, *Glass in building — Determination of luminous and solar characteristics of glazing*

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

EN 14500, *Blinds and shutters — Thermal and visual comfort — Test and calculation methods*

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, ISO 9288, ISO 9488, 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
solar radiation and light
radiation in the whole solar spectrum or any part of it, comprising ultra-violet, visible and near infrared radiation in the wavelength range of 0,3 µm to 2,5 µm

Note 1 to entry: Sometimes called shortwave radiation, see ISO 9488.

3.2
thermal radiation
radiation emitted by any surface at or near ambient temperature in the far infrared in the wavelength range of 3 µm to 100 µm

Note 1 to entry: The definition deviates from ISO 9288.

Note 2 to entry: Sometimes called longwave radiation, see ISO 9488.

3.3
total solar energy transmittance
total transmitted fraction of the incident solar radiation consisting of direct transmitted solar radiation and the part of the absorbed solar radiation transferred by convection and thermal radiation to the internal environment

3.4
light transmittance
transmitted fraction of the incident solar radiation in the visible part of the solar spectrum

Note 1 to entry: See also EN 410 and ISO 9050.

3.5
normalized radiant flow rate
radiant flow rate divided by the incident radiant flow rate

3.6
EPB standard
standard that complies with the requirements given in ISO 52000-1, CEN/TS 16628[2] and CEN/TS 16629[3]

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
E_S	incident solar radiation flow rate, solar irradiation	W/m²
I	normalized radiant flow rate	—
H	height of a ventilated space	m
T	thermodynamic temperature	K
U	thermal transmittance	W/(m²·K)
Z	pressure loss factor	—
g	total solar energy transmittance (solar factor)	—
h	heat transfer coefficient or thermal conductance of gas space	W/(m²·K)
q	density of heat flow rate	W/m²
s	width of a space	m
z	vertical coordinate	m
ε	thermal emissivity	—
α	absorptance	—
α_e	solar direct absorptance	—
λ	thermal conductivity	W/(m·K)
λ	wavelength	µm
ρ	reflectance of the side facing the incident radiation	—
ρ'	reflectance of the side facing away from the incident radiation	—
ρ_e	solar direct reflectance	—
ρ_v	light reflectance	—
σ	Stefan-Boltzmann constant	$5{,}67 \times 10^{-8}$ W/(m²·K⁴)
τ_e	solar direct transmittance	—
τ_v	light transmittance	—

4.2 Subscripts

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

Subscript	Definition
a	absorbed
c	conductive/convective
d	diffuse

Subscript	Definition
e	external environment
g	gas
i	internal environment
j, *k*	integer, number of layer or space
r	radiant
tot	total
th	thermal radiation
v	ventilated
B	blind
D	direct

5 Description of the method

5.1 Output of the method

The possible outputs of this document are the following:

— the total solar energy transmittance for a glazing in combination with an external or internal or integrated solar protection device, g_{tot};

— the total solar direct transmittance for a glazing in combination with an external or internal or integrated protection device, $\tau_{e,tot}$;

— the total light transmittance for a glazing in combination with an external or internal or integrated solar protection device, $\tau_{v,tot}$.

5.2 General description

In general, the total solar energy transmittance, the total solar direct transmittance and the total light transmittance is calculated as a function of the thermal resistance and spectral “optical” properties (transmittance, reflectance) of the individual layers.

Throughout this document, where indicated in the text, Table C.1 shall be used to identify alternative regional references in line with ISO Global Relevance Policy.

6 Calculation method

6.1 Output data

The main output of this document are the total solar energy transmittance, the total solar direct transmittance and the total light transmittance for a glazing in combination with a solar protection device (see Table 2).

Table 2 — Output data

Description	Symbol	Unit	Destination module	Validity interval	Varying
Total solar energy transmittance	g_{tot}	—	M2-2, M2-3, M2-4	0 to 1	NO
Total solar direct transmittance	$\tau_{e,tot}$	—	M2-2, M2-3, M2-4	0 to 1	NO
Total light transmittance	$\tau_{v,tot}$	—	M2-2, M2-3, M2-4	0 to 1	NO

6.2 Calculation time intervals

The input, the method and the output data are for steady state conditions and therefore, there are no time intervals.

6.3 Input data

6.3.1 Solid layers

The glass panes and the solar protection devices are considered as solid layers. The relevant characteristics are as follows:

— for solar radiation and light: the spectral transmittance and the spectral reflectances of both sides;

— for thermal radiation: the transmittance and the emissivities of both sides.

For the determination of the characteristics of the glazing, see the procedures recommended for glazing materials in EN 410 or ISO 9050; for solar shading devices, procedures given in EN 14500 are used. However, for louvres or venetian blinds, Annex D gives a method to calculate equivalent values based on similarly determined material properties.

NOTE Usually, these values are determined directly by the most appropriate optical method. For more information on the determination of the characteristics, see CIE 130-1998 “Practical Methods for the measurement of reflectance and transmittance”.

The individual layers are characterized by the quantities according to Table 3.

Table 3 — Identifiers for characteristics of the solid layers

Name	Symbol	Unit	Range	Origin	Varying
Spectral transmittance of the side of the solid layer facing the incident radiation	$\tau(\lambda)$	—	0 to1	ISO 9050 for glazing, EN 14500 for shading (or see Subject 1 in Table C.1)	No
Spectral transmittance of the side of the solid layer facing away from the incident radiation	$\tau'(\lambda)$	—	0 to1	ISO 9050 for glazing, EN 14500 for shading (or see Subject 1 in Table C.1)	No
Spectral reflectance of the side of the solid layer facing the incident radiation	$\rho(\lambda)$	—	0 to1	ISO 9050 for glazing, EN 14500 for shading (or see Subject 1 in Table C.1)	No