



BSI Standards Publication

Energy performance of buildings – Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads

Part 1: Calculation procedures

National foreword

This British Standard is the UK implementation of EN ISO 52016-1:2017. Together with BS EN ISO 52017-1:2017, it supersedes BS EN 15265:2007, BS EN 15255:2007, BS EN ISO 13791:2012 and BS EN ISO 13792:2012. It supersedes BS EN ISO 13790:2008, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/540/2, Building performance - Moisture.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads - Part 1: Calculation procedures (ISO 52016-1:2017)

Performance énergétiques des bâtiments - Besoins d'énergie pour le chauffage et le refroidissement, les températures intérieures et les chaleurs sensible et latente - Partie 1: Méthodes de calcul (ISO 52016-1:2017)

Energetische Bewertung von Gebäuden - Berechnung des Energiebedarfs für Heizung und Kühlung, Innentemperaturen sowie der Heiz- und Kühllast in einem Gebäude oder einer Gebäudezone - Teil 1: Berechnungsverfahren (ISO 52016-1:2017)

This European Standard was approved by CEN on 27 February 2017.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

This document (EN ISO 52016-1:2017) has been prepared by Technical Committee ISO/TC 163 "Thermal performance and energy use in the built environment" in collaboration with Technical Committee CEN/TC 89 "Thermal performance of buildings and building components" the secretariat of which is held by SIS.

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 2018 and conflicting national standards shall be withdrawn at the latest by January 2018.

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

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document is part of the set of standards on the energy performance of buildings (the set of EPB standards) and has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480, see reference [EF1] below), and supports essential requirements of EU Directive 2010/31/EC on the energy performance of buildings (EPBD, [EF2]).

In case this standard 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, in particular for the application within the context of EU Directives transposed into national legal requirements.

Further target groups are users of the voluntary common European Union certification scheme for the energy performance of non-residential buildings (EPBD art.11.9) and any other regional (e.g. Pan European) parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

This International Standard cancels and replaces EN ISO 13790 that was developed during the first EPBD mandate (M/343) and was published in 2008.

This document supersedes EN 15255:2007, EN 15265:2007, EN ISO 13790:2008, EN ISO 13791:2012, EN ISO 13792:2012.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

References:

[EF1] Mandate M/480, Mandate to CEN, CENELEC and ETSI for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings, in accordance with the terms set in the recast of the Directive on the energy performance of buildings (2010/31/EU) of 14th December 2010

[EF2] EPBD, Recast of the Directive on the energy performance of buildings (2010/31/EU) of 14th December 2010

[EF3] EN 15265:2007, Energy performance of buildings — Calculation of energy needs for space heating and cooling using dynamic methods — General criteria and validation procedures

[EF4] EN 15255:2007, Thermal performance of buildings Sensible room cooling load calculation - General criteria and validation procedures

Endorsement notice

The text of ISO 52016-1:2017 has been approved by CEN as EN ISO 52016-1:2017 without any modification.

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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.

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

A list of all parts in the ISO 52016 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 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 of [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](#). 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 52016-2[1]).

The subset of EPB documents prepared under the responsibility of ISO/TC 163/SC 2 (*Thermal performance and energy use in the built environment, Calculation methods*) cover inter alia:

- calculation procedures on the overall energy use and energy performance of buildings;
- calculation procedures on the internal temperature in buildings (e.g. in case of no space heating or cooling);

- indicators for partial EPB requirements related to thermal energy balance and fabric features; 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 TCs for the details on e.g. appliances, technical building systems and indoor environment.

This document presents a coherent set of calculation methods at different levels of detail, for the energy needs involved in the space heating and cooling and for (de-)humidification of a building and/or for the internal temperatures and (sensible or latent) heat loads, including the influence from technical buildings systems, control aspects and boundary conditions where relevant for the calculation.

The result of the design loads is also of possible use for the checking of the appropriate sizing of the equipment at the occasion of inspections.

References are made to other International Standards or to national documents for input data and detailed calculation procedures not provided by this document.

This document supersedes ISO 13790:2008. The main differences are:

- integration in the set of EPB standards, as specified in the overarching EPB standard (ISO 52000-1). Including removal of calculation elements that are covered or to be covered in other standards (for instance, the general rules for zoning (partitioning) of the building is now at overarching level (EPB module M1-8); the conditions of use are now assumed to be in a separate standard (module M1-6);
- major editorial changes based on the detailed technical rules for all EPB standards. Including moving all informative annexes to a separate accompanying Technical Report (ISO/TR 52016-2^[1]);
- revision of the monthly calculation method and removal of the seasonal method;
- replacement of the simple hourly calculation method by a more direct and transparent method, with no need to add input data;
- integration of the calculation of the design heating and cooling load, including latent heat load, initially prepared as prEN 16798-11:2015 by CEN/TC 156.

Relevant editorial changes have been made based on the detailed technical rules for all EPB standards, including moving all informative annexes, if not covered elsewhere, to a separate accompanying Technical Report (ISO/TR 52016-2^[1]).

Together with ISO 52017-1 this document also supersedes ISO 13791:2012^[3] and ISO 13792:2012^[4].

[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^[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 [Clause 2](#) and [Tables A.1](#) and [B.1](#).

Table 1 — Position of this document (in casu M2-2, M2-3, M2-6, M3-3, M4-3, M6-3, M7-3), 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	52016-1	Needs								a	
3	Applications		(Free) Indoor conditions without systems	52016-1	Maximum load and power	52016-1	52016-1		52016-1	52016-1				
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	52016-1	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													

NOTE The shaded modules are not applicable.

Energy performance of buildings — Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads —

Part 1: Calculation procedures

1 Scope

This document specifies calculation methods for the assessment of:

- a) the (sensible) energy need for heating and cooling, based on hourly or monthly calculations;
- b) the latent energy need for (de-)humidification, based on hourly or monthly calculations;
- c) the internal temperature, based on hourly calculations;
- d) the sensible heating and cooling load, based on hourly calculations;
- e) the moisture and latent heat load for (de-)humidification, based on hourly calculations;
- f) the design sensible heating or cooling load and design latent heat load using an hourly calculation interval;
- g) the conditions of the supply air to provide the necessary humidification and dehumidification.

The calculation methods can be used for residential or non-residential buildings, or a part of it, referred to as “the building” or the “assessed object”.

This document also contains specifications for the assessment of thermal zones in the building or in the part of a building. The calculations are performed per thermal zone. In the calculations, the thermal zones can be assumed to be thermally coupled or not.

The calculation methods have been developed for the calculation of the basic energy loads and needs, without interaction with specific technical building systems, and for the calculation of the system specific energy loads and needs, including the interaction with specific systems. The hourly calculation procedures can also be used as basis for calculations with more extensive system control options.

This document is applicable to buildings at the design stage, to new buildings after construction and to existing buildings in the use phase.

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

ISO 10077-1, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General*

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

ISO 13789:2017, *Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method*

ISO 15099, *Thermal performance of windows, doors and shading devices — Detailed calculations*

ISO 15927-2, *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 2: Hourly data for design cooling load*

ISO 15927-4, *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 4: Hourly data for assessing the annual energy use for heating and cooling*

ISO 15927-5, *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 5: Data for design heat load for space heating*

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 12831-1, *Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3*

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, in 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 Building

3.1.1

assessed object

building, part of a building or portfolio of buildings that is the object of the energy performance assessment

Note 1 to entry: The assessed object comprises all spaces and technical systems which may contribute to or influence the energy performance assessment.

Note 2 to entry: The assessed object may include one or several building units, if these are not individually object of the energy performance assessment.

Note 3 to entry: A distinction may be made between e.g. a designed building, new building after construction, existing building in the use phase and existing building after major renovation.

[SOURCE: ISO 52000-1:2017, 3.1.1]

3.1.2 building

construction as a whole, including the fabric and all technical building systems, where energy may be used to condition the indoor environment, to provide domestic hot water and illumination and other services related to the use of the building

Note 1 to entry: The term refers to the physical building as a whole or to all parts thereof that at least include the spaces and technical building systems that are relevant for the energy performance assessment.

Note 2 to entry: Parts of a building can be physically detached, but are on the same building site. For example: a canteen or a guard house or one or more classrooms of a school in a detached part of a building; or an essential space in a dwelling (e.g. bedroom).

[SOURCE: ISO 52000-1:2017, 3.1.2]

3.1.3 building category unit category

classification of buildings and/or building units related to their main use or their special status, for the purpose of enabling differentiation of the energy performance assessment procedures and/or energy performance requirements

EXAMPLE Buildings officially protected as part of a designated environment or because of their special architectural or historical merit, buildings used as places of worship and for religious activities, residential buildings, (a) single-family houses of different types; (b) apartment blocks; (c) offices; (d) educational buildings; (e) hospitals; (f) hotels and restaurants; (g) sports facilities; (h) wholesale and retail trade services buildings; (i) data centers; (j) other types of energy-consuming buildings.

Note 1 to entry: Building regulation often make a distinction between building categories.

Note 2 to entry: The building category, for instance, may determine if energy performance assessment is mandatory (e.g. not for religious or historic buildings) and which are the minimum energy performance requirements (e.g. for new buildings); in some countries measured energy performance of a building is prescribed for specific categories of buildings (e.g. apartment buildings, large public buildings), etc. Another type of categorization is the distinction between new and existing and renovated buildings.

Note 3 to entry: Many buildings or building units of a given (use) category contain spaces of different (use) categories; for instance an office building may contain a restaurant; see [3.1.20](#) definition of space category.

Note 4 to entry: The allocation of a building category may also have a strong impact on other parts of the building regulations, for instance on safety (e.g. emergency exits, strength of floor) or indoor environmental quality (e.g. minimum ventilation rates)

[SOURCE: ISO 52000-1:2017, 3.1.3]

3.1.4 building element

integral component of the technical building systems or of the fabric of a building

[SOURCE: ISO 52000-1:2017, 3.1.4]

3.1.5 building fabric

all physical elements of a building, excluding technical building systems

EXAMPLE Roofs, walls, floors, doors, gates and internal partitions.

Note 1 to entry: It includes elements both inside and outside of the thermal envelope, including the thermal envelope itself.

Note 2 to entry: The fabric determines the thermal transmission, the thermal envelope airtightness and (nearly all of) the thermal mass of the building (apart from the thermal mass of furniture and technical building systems). The fabric also makes the building wind and water tight. The building fabric is sometimes described as the building as such, i.e. the building without any technical building system.

[SOURCE: ISO 52000-1:2017, 3.1.5]

3.1.6 building portfolio

set of buildings and common technical building systems whose energy performance is determined taking into account their mutual interactions

Note 1 to entry: An example of common equipment is an energy generation system (PV panels, wind turbine, cogen unit, boiler etc.) serving the building portfolio

[SOURCE: ISO 52000-1:2017, 3.1.6]

3.1.7 building thermal zone thermal zone

internal environment with assumed sufficiently uniform thermal conditions to enable a thermal balance calculation according to the procedures in the standard under EPB module M2-2

Note 1 to entry: The EPB standard under module M2-2 is this document.

[SOURCE: ISO 52000-1:2017, 3.1.6, modified - Note 1 to entry modified to “this document”]

3.1.8 building unit

section, floor or apartment within a building which is designed or altered to be used separately from the rest of the building

EXAMPLE A shop in a shopping mall, an apartment in an apartment building or a rentable office space in an office building.

Note 1 to entry: The building unit can be the assessed object.

[SOURCE: ISO 52000-1:2017, 3.1.8]

3.1.9 conditioned space

room or enclosure that is covered by one or more of the EPB services

3.1.10 cooled space

room or enclosure, which for the purposes of a calculation is assumed to be cooled to a given temperature set-point or set-points

[SOURCE: ISO 52000-1:2017, 3.1.9]

3.1.11 elementary space space

room, part of a room or group of adjacent rooms that belongs to one thermal zone and one service area of each service, used to administer the boundaries of the thermal zones and service areas and to administer the exchange of data between the service areas and thermal zones

[SOURCE: ISO 52000-1:2017, 3.1.10]

3.1.12**external dimension**

dimension measured on the exterior of a building

Note 1 to entry: See ISO 13789:2017, [Figure 1](#).

[SOURCE: ISO 13789:2017, 3.13]

3.1.13**heated space**

room or enclosure, which for the purposes of a calculation is assumed to be heated to a given temperature set-point or set-points

[SOURCE: ISO 52000-1:2017, 3.1.11]

3.1.14**internal dimension**

dimension measured from wall to wall and floor to ceiling inside a room of a building

Note 1 to entry: See ISO 13789:2017, [Figure 1](#).

[SOURCE: ISO 13789:2017, 3.11]

3.1.15**overall internal dimension**

dimension measured on the interior of a building, ignoring internal partitions

Note 1 to entry: See ISO 13789:2017, [Figure 1](#).

[SOURCE: ISO 13789:2017, 3.12]

3.1.16**projected area of solar collecting elements**

area of the projection of the surface of the element on to a plane parallel to the transparent or translucent part of the element

Note 1 to entry: In the case of non-flat elements, this refers to the area of the imaginary of the smallest plane connecting the perimeter of the element.

EXAMPLE Windows.

3.1.17**projected area of frame elements**

area of the projection of the frame element on to a plane parallel to the glazing or panel that is held by the frame

EXAMPLE Window frames.

3.1.18**reference floor area**

floor area used as a reference size

Note 1 to entry: See definition of reference size.

[SOURCE: ISO 52000-1:2017, 3.1.12]

3.1.19**reference size**

relevant metric to normalize the overall or partial energy performance and energy performance requirements to the size of the building or part of a building and for the comparison against benchmarks

[SOURCE: ISO 52000-1:2017, 3.1.13]

3.1.20

space category

classification of building spaces related to a specific set of use conditions

EXAMPLE Office space, restaurant space, entrance hall, toilet, living space, assembly hall, shop, residential bed room, indoor car park, heated indoor stair case, unheated indoor stair case, etc.

Note 1 to entry: The space category is relevant for the calculation of the energy performance assessment and for defining the reference size.

[SOURCE: ISO 52000-1:2017, 3.1.14]

3.1.21

thermal envelope area

total area of all elements of a building that enclose thermally conditioned spaces through which thermal energy is transferred, directly or indirectly, to or from the external environment

Note 1 to entry: The thermal envelope area depends on whether internal, overall internal or external dimensions are being used.

Note 2 to entry: The thermal envelope area does not include the area to adjacent buildings; see ISO 13789.

Note 3 to entry: The thermal envelope area may play a role in the ways to express the overall and partial energy performance and energy performance requirements and comparison against benchmarks.

[SOURCE: ISO 13789:2017, 3.9, modified, Notes 2 and 3 to entry added]

3.1.22

thermally conditioned space

heated and/or cooled space

[SOURCE: ISO 52000-1:2017, 3.1.16]

3.1.23

thermally unconditioned space

room or enclosure that is not part of a thermally conditioned space

[SOURCE: ISO 52000-1:2017, 3.1.17]

3.1.26

useful floor area

<for EPB assessment> area of the floor of a building needed as parameter to quantify specific conditions of use that are expressed per unit of floor area and for the application of the simplifications and the zoning and (re-)allocation rules

[SOURCE: ISO 52000-1:2017, 3.1.18]

3.2 Indoor and outdoor conditions

3.2.1

condition of use

requirement and/or restriction for the use of a building space category, related to the services for the energy performance assessment and/or the boundary conditions

EXAMPLE Heating set-point, cooling set-point, minimum amount of ventilation related to air quality, net domestic hot water needs (e.g. per m² floor area or per person), lighting levels, internal heat gains, etc. ; including the distribution over time (operation). Where relevant, the numbers are based on the number of occupants per m² per type of building space.

[SOURCE: ISO 52000-1:2017, 3.2.1]

3.2.2**external temperature**

temperature of outdoor air

[SOURCE: ISO 52000-1:2017, 3.2.3]

3.2.3**intermittent heating or cooling**

heating or cooling pattern where normal heating or cooling periods alternate with periods of reduced or no heating or cooling

3.2.4**internal temperature****operative temperature**

weighted average of the air temperature and the mean radiant temperature at the centre of the thermal zone

Note 1 to entry: Internal temperature is the approximate operative temperature according to ISO 7726.

Note 2 to entry: Operative temperature is the term used in this document.

Note 3 to entry: ISO 52017-1 uses a more generic definition.

[SOURCE: for internal temperature: ISO 52000-1:2017, 3.2.4, modified, Notes 2 and 3 to entry added]

3.2.5**internal air temperature**

temperature of the air in the internal environment

3.2.6**mean radiant temperature**

uniform surface temperature of the internal environment in which an occupant would exchange the same amount of radiant heat as in the actual non-uniform enclosure

3.2.7**set-back temperature**

minimum internal temperature to be maintained during reduced heating periods, or maximum internal temperature to be maintained during reduced cooling periods

3.2.8**set-point (of the internal) temperature**

internal (minimum intended) operative temperature for the calculation of the energy load or need for heating, or internal (maximum intended) temperature for the calculation of the energy load or need for cooling

Note 1 to entry: The values and duration (pattern) are specified in the standard under EPB module M1-6. For monthly and seasonal methods, the value of the set-point can include adjustment for intermittency, as specified in 6.6.11. For system-specific calculations the values may be adjusted due to system control features.

3.2.9**solar irradiance**

power density of radiation incident on a surface, i.e. the quotient of the radiant flux incident on the surface and the area of that surface, or the rate at which radiant energy is incident on a surface, per unit area of that surface

[SOURCE: ISO 52000-1:2017, 3.2.6]

3.2.10

solar irradiation

incident solar heat per area over a given period

Note 1 to entry: Incident energy per unit area of a surface, found by integration of solar irradiance over a specified time interval, often an hour or a day (ISO 9488).

[SOURCE: ISO 52000-1:2017, 3.2.7]

3.3 Technical building systems

3.3.1

building service

service provided by the technical building systems and by appliances to provide the indoor environment conditions, domestic hot water, illumination levels and other services related to the use of the building

[SOURCE: ISO 52000-1:2017, 3.3.3]

3.3.2

building service area (service area)

part of a building consisting of one or more elementary spaces served by a specific technical building system or sub-system

Note 1 to entry: Building service area for a specific heating system circuit, for a specific cooling system circuit, for a specific domestic hot water distribution system, for a specific ventilation system, for a specific air conditioning system, for a specific lighting (artificial light or daylight) configuration.

[SOURCE: ISO 52000-1:2017, 3.3.4]

3.3.3

other building service

service supplied by energy-consuming appliances

[SOURCE: ISO 52000-1:2017, 3.2.5]

3.3.4

recoverable system thermal loss

part of a system thermal loss which can be recovered to lower either the energy need for heating or cooling or the energy use of the heating or cooling system

Note 1 to entry: This depends on the calculation approach chosen to calculate the recovered gains and losses (detailed or simplified approach; see ISO 52000-1:2017, 11.3).

Note 2 to entry: In this document, if not directly taken into account as a reduction to the system losses, the recoverable system thermal losses are calculated as part of the internal heat gains. It may be decided at national level to report the recoverable system thermal losses separately from the other internal heat gains.

[SOURCE: ISO 52000-1:2017, 3.3.9; modified, Note 1 to entry editorially revised, Note 2 to entry added.]

3.3.5

recovered system thermal loss

part of a recoverable system thermal loss which has been recovered to lower either the energy need for heating or cooling or the energy use of the heating or cooling system

Note 1 to entry: This depends on the calculation approach chosen to calculate the recovered gains and losses (detailed or simplified approach; see ISO 52000-1:2017, 11.3).

[SOURCE: ISO 52000-1:2017, 3.3.10; modified, Note 1 to entry editorially revised]

3.3.6**system thermal loss**

thermal loss from a technical building system for heating, cooling, domestic hot water, humidification, dehumidification or ventilation that does not contribute to the useful output of the system

Note 1 to entry: A system loss can become an internal heat gain for the building if it is recoverable.

Note 2 to entry: Thermal energy recovered directly in the sub-system is not considered as a system thermal loss but as heat recovery and directly treated in the related system standard under EPB module M3 to M8.

Note 3 to entry: Heat dissipated by the lighting system or by other services (e.g. appliances of computer equipment) is not part of the system thermal losses, but part of the internal heat gains.

[SOURCE: ISO 52000-1:2017, 3.3.11]

3.3.7**technical building sub-system**

part of a technical building system that performs a specific function (e.g. heat generation, heat distribution, heat emission)

[SOURCE: ISO 52000-1:2017, 3.3.12]

3.3.8**technical building system**

technical equipment for heating, cooling, ventilation, humidification, dehumidification, domestic hot water, lighting, building automation and control and electricity production

Note 1 to entry: A technical building system can refer to one or to several building services (e.g. heating, heating and domestic hot water).

Note 2 to entry: A technical building system is composed of different sub-systems.

Note 3 to entry: Electricity production can include cogeneration, wind power and photovoltaic systems.

[SOURCE: ISO 52000-1:2017, 3.3.13]

3.4 Energy**3.4.1****dehumidification**

process of removing water vapour from air

[SOURCE: ISO 52000-1:2017, 3.4.5]

3.4.2**design load**

maximum hourly mean value of the load, occurring during a design climate period under design use conditions

3.4.3**energy need for heating or cooling**

heat to be delivered to, or extracted from, a thermally conditioned space to maintain the intended space temperature conditions during a given period of time

[SOURCE: ISO 52000-1:2017, 3.4.13]

3.4.4**energy need for humidification or dehumidification**

latent heat in the water vapour to be delivered to or extracted from a thermally conditioned space by a technical building system to maintain a specified minimum or maximum humidity within the space

[SOURCE: ISO 52000-1:2017, 3.4.14]

3.4.5

energy use for lighting

electrical energy input to a lighting system

[SOURCE: ISO 52000-1:2017, 3.4.16]

3.4.6

energy use for other services

energy input to appliances providing services not included in the EPB services

Note 1 to entry: See definition of EPB services.

EXAMPLE Elevators, escalators, home appliances, TV, computers, etc. (if not covered under EPB services)

[SOURCE: ISO 52000-1:2017, 3.4.17]

3.4.7

energy use for space heating or cooling or domestic hot water

energy input to the heating, cooling or domestic hot water system to satisfy the energy need for heating, cooling (including dehumidification) or domestic hot water respectively

[SOURCE: ISO 52000-1:2017, 3.4.18]

3.4.8

energy use for ventilation

electric energy input to a ventilation system for air transport and heat recovery

[SOURCE: ISO 52000-1:2017, 3.4.19]

3.4.9

humidification

process of adding water vapour to air to increase humidity

[SOURCE: ISO 52000-1:2017, 3.4.22]

3.4.10

humidification or dehumidification moisture load

hourly mean value of the water vapour mass flow to be supplied to, or extracted from the internal environment to maintain a specified minimum or maximum humidity within the space

3.4.11

latent heating or cooling load

hourly mean value of the latent heat in the water vapour to be supplied to or extracted from the internal environment to maintain the intended space air moisture conditions

3.4.12

lighting

process of providing illumination

[SOURCE: ISO 52000-1:2017, 3.4.23]

3.4.13

(sensible) heating or cooling load

hourly mean value of the heating or cooling heat flow rate supplied to or extracted from the internal environment to maintain the intended space temperature conditions

3.4.14

space cooling

process of extracting heat from a building space with the aim of reaching and maintaining a given maximum space temperature

[SOURCE: ISO 52000-1:2017, 3.4.30]

3.4.15**space heating**

process of heat supply to a building space with the aim of reaching and maintaining a given minimum space temperature

[SOURCE: ISO 52000-1:2017, 3.4.31]

3.4.16**ventilation**

process of supplying or removing air by natural or mechanical means to or from a space or building

[SOURCE: ISO 52000-1:2017, 3.4.33]

3.4.17**ventilation-heat recovery**

heat recovered from exhaust air to reduce the ventilation heat transfer

3.5 Energy performance**3.5.1****energy performance****overall energy performance**

<of an assessed object> calculated or measured amount of (weighted) energy needed to meet the energy demand associated with a typical use of the assessed object, which includes energy used for specific services (EPB services)

Note 1 to entry: See definition of EPB services and definition of assessed object.

Note 2 to entry: Also called overall energy performance, to distinguish from partial energy performance.

[SOURCE: ISO 52000-1:2017, 3.5.7]

3.5.2**EPB service**

building service included in the assessment of the energy performance

Note 1 to entry: See definition of building service. Which services are included is a national or regional choice, specified in ISO 52000-1:2017, Annexes A and B.

EXAMPLE Energy used for heating, cooling, ventilation, humidification, dehumidification, domestic hot water and lighting.

[SOURCE: ISO 52000-1:2017, 3.5.13]

3.5.3**EPB standard**

standard that complies with the requirements given in ISO 52000-1, CEN/TS 16628^[5] and CEN/TS 16629^[6]

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, 3.5.14]

3.6 Energy calculation

3.6.1

calculation period

period of time over which a calculation is performed

Note 1 to entry: The calculation period can be divided into a number of calculation intervals.

Note 2 to entry: The calculation period is usually a whole year for domestic hot water and ventilation, and a season for cooling and heating.

Note 3 to entry: The length of the calculation period [e.g. heating or cooling season] may be a result of the calculation or may be imposed for specific applications

[SOURCE: ISO 52000-1:2017, 3.6.4]

3.6.2

calculation interval

calculation time interval

discrete time interval for the calculation of the energy performance

EXAMPLE One hour, one month, one heating and/or cooling season, one year, operating modes and bins.

[SOURCE: ISO 52000-1:2017, 3.6.3; modified - alternative term added]

3.6.3

calculation with coupled zones

multi-zone calculation with thermal coupling between zones, taking into account any heat transfer by thermal transmission and/or by ventilation and/or by air infiltration between zones

3.6.4

calculation with uncoupled zones

multi-zone calculation without thermal coupling between zones, not taking into account any heat transfer by thermal transmission or by ventilation or by air infiltration between zones

3.6.5

gain utilization factor

factor reducing the total monthly heat gains in the monthly calculation method, to obtain the resulting reduction of the building energy need for heating

3.6.6

heat-balance ratio

monthly heat gains divided by the monthly heat transfer

3.6.7

heat gain

heat generated within, or entering into, the thermally conditioned space from heat sources other than energy intentionally utilized for heating, cooling or domestic hot water preparation

Note 1 to entry: Internal heat gains and solar heat gains. Sinks that extract heat from the building, are examples of heat gains, with a negative sign.

Note 2 to entry: For summer conditions heat gains with a positive sign constitute extra heat load on the space.

[SOURCE: ISO 52000-1:2017, 3.6.5]

3.6.8

heating or cooling season

period of the year during which a significant amount of energy for heating or cooling is needed

Note 1 to entry: The season lengths are used to determine the operation period of technical systems.

[SOURCE: ISO 52000-1:2017, 3.6.6]

3.6.9**heat transfer coefficient**

heat flow rate divided by the temperature difference between two environments; specifically used for heat transfer coefficient by transmission or ventilation

Note 1 to entry: In contrast with a heat gain, the driving force for heat transfer is the difference between the temperature in the considered space and the temperature of the environment at the other side (in the case of transmission) or the supply air temperature (in the case of ventilation).

3.6.10**internal heat gain**

heat provided within the building by occupants (sensible metabolic heat) and by appliances such as domestic appliances, office equipment, etc., other than energy intentionally provided for heating, cooling or hot water preparation

Note 1 to entry: In this document, if not directly taken into account as a reduction to the system thermal losses, the recoverable system thermal losses are included as part of the internal heat gains. It may be decided at national level to report the recoverable system thermal losses separately.

Note 2 to entry: Included are heat from (warm) or to (cold) process sources that are not controlled for the purpose of heating or cooling or domestic hot-water preparation. The heat extracted from the building, from the indoor environment to cold sources (sinks), is included as gain with a negative sign.

[SOURCE: ISO 52000-1:2017, 3.6.7; modified, Notes 1 and 2 to entry adapted]

3.6.11**loss utilization factor**

factor reducing the total monthly heat transfer in the monthly calculation method, to obtain the resulting reduction of the energy need for cooling

Note 1 to entry: The traditional term “loss”, which originally referred to the heating mode only, is retained for the utilization factor for losses; if the losses are “negative”, there is no utilization.

3.6.12**solar heat gain**

heat provided by solar radiation entering, directly or indirectly (after absorption in building elements), into the building through windows, opaque walls and roofs, or passive solar devices such as sunspaces, transparent insulation and solar walls

Note 1 to entry: Active solar devices such as solar collectors are considered as part of the technical building system.

[SOURCE: ISO 52000-1:2017, 3.6.10]

3.6.13**transmission heat transfer coefficient**

heat flow rate due to thermal transmission through the fabric of a building, divided by the difference between the environment temperatures on either side of the construction

Note 1 to entry: By convention, the sign is positive if the heat flow is going out of the space considered (heat loss).

3.6.14**unoccupied period**

period of several days or weeks without heating or cooling

EXAMPLE Due to holidays

3.6.15**useful heat gain**

part of internal and solar heat gains that contribute to reducing the energy need for heating

[SOURCE: ISO 52000-1:2017, 3.6.11]

3.6.16

ventilation heat transfer coefficient

heat flow rate due to air entering an enclosed space, either by infiltration or ventilation, divided by the difference between the internal air temperature and the supply air temperature

Note 1 to entry: The sign of the coefficient is always positive. By convention, the sign of the heat flow is positive if the supply air temperature is lower than the internal air temperature (heat loss).

4 Symbols, subscripts and abbreviations

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
a_{sol}	solar absorption coefficient	—
a	numerical parameter in utilization factor	—
b	temperature reduction factor	—
C	heat capacity	J/K
c	specific heat capacity	$\text{J}/(\text{kg}\cdot\text{K})$
D	depth	m
d	thickness	m
F or f	factor, fraction	—
G	moisture flow	kg/s
g	total solar energy transmittance	—
H	height	m
H	heat transfer coefficient	W/K
H_{sol}	(accumulated, monthly) solar irradiation	kWh/m^2
h	surface coefficient of heat transfer	$\text{W}/(\text{m}^2\cdot\text{K})$
h	(partial) height	m
h	latent heat	J/kg
I_{sol}	solar irradiance	W/m^2
L, l	length	m
N	number of items (integer only)	—
Q	quantity of heat	kWh^{a}
q	heat flow density	W/m^2
qv	air volume flow rate	m^3/h
R	thermal resistance	$\text{m}^2\cdot\text{K/W}$
S	space	
T	thermodynamic temperature	K
T	accumulated over- or undertemperature	$\text{K}\cdot\text{h}$
t	time	s
U	thermal transmittance	$\text{W}/(\text{m}^2\cdot\text{K})$
V	volume	m^3
W	width	m
w	(partial) width	m

^a Hours (h) are used as the unit of time instead of seconds when aggregating heat or energy flow (W) to quantity of heat or energy (kWh).

w	weighting factor	-
x	moisture content or mixing ratio	kg/kg dry air
Z	heat transfer parameter for solar walls	W/(m ² ·K)
Z	zone	
α_{sol}	solar altitude angle	°
β	tilt angle	°
γ	azimuth angle	°
γ	heat-balance ratio	—
δ	(solar) declination	°
ε	long-wave emissivity of the surface	—
η	efficiency, utilization factor	—
θ	Celsius temperature	°C
φ	relative humidity	%
φ	latitude	°
φ_{sol}	solar azimuth angle	°
κ	areal heat capacity	J/(m ² ·K)
ν	humidity by volume	kg/m ³
ρ	density	kg/m ³
σ	Stefan-Boltzmann constant	W/(m ² ·K ⁴)
τ	time constant	s ^a
Φ	heat flow rate, heat load, power	W
Ψ	linear thermal transmittance	W/(m·K)
^a Hours (h) are used as the unit of time instead of seconds when aggregating heat or energy flow (W) to quantity of heat or energy (kWh).		

4.2 Subscripts

For the purposes of this document, the subscripts given in ISO 52000-1:2017, Clause 4, Annex C and the following apply.

NOTE Relevant subscripts already given in ISO 52000-1 are included if necessary for the understanding of this document.

Subscript	Term	Subscript	Term	Subscript	Term
a	air	ht	heat transfer	re	radiative external (~r;e)
A	appliances ^a	HVAC	heating, ventilation, air conditioning	red	reduced
adj	adjusted	i	internal	ri	radiative internal (~r;i)
ahu	air handling unit	i,j,k,z	indexes	s	surface
alt	altitude	int	internal or indoor ^c	se	surface external
an	annual	interm	intermittent	set	set-point
C	cooling ^a	iu	from thermally conditioned internal) to thermally unconditioned zone	sh	shading

^a Type of energy use (energy service)

^b The subscript “e” is used for the term “external”, in contrast with “internal”. But if there is a risk of confusion between “external” to (for instance) a construction in general and “external”, meaning outdoor environment, then the term “outdoor” is recommended for the latter.

^c The subscript “int” is used for the term “internal”, in contrast with “external”. But if there is a risk of confusion between “internal” in a construction and “internal” in a building or thermal zone, then the term “indoor” is recommended for the latter.

Subscript	Term	Subscript	Term	Subscript	Term
c	structure, construction element	L	lighting ^a	sht	shutter
c	convection, convective	ld	load	sol	solar
calc	calculation	lim	limited	spec	specific
ce	convective external (~c;e)	lr	long-wave radiation	ss	subsystem
ci	convective internal (~c;i)	ls	loss	stc	thermally conditioned space
cont	continuous	m	monthly	sup	supply
cu	from thermally conditioned to thermally unconditioned zone	m	mass related conductance or capacitance	sys	system
cw	curtain walling	mn	mean	T	thermal ^a
d	door	n	normal to surface	t	time
day	daily	nd	need	tel	transparent element
DHU	dehumidification ^a	nlim	unlimited	tot	total
dif	diffuse	noc	unoccupied period	tr	transmission (heat transfer)
dir	direct	obst	obstacles	u	unconditioned
e	external or outdoor ^b	oc	occupants	UC	undersizing cooling system
eff	effective	occ	occupied period	ue	from unconditioned to external environment
el	element	oel	opaque element	UH	undersizing heating system
fin, finl, finr, fins	(side) fin (left, right, both)	OH	overheating	use	useful
fl	floor	op	operative	vi	virtual
fr	frame	op	opaque	ve	ventilation (heat transfer)
gr	ground	ovh	overhang	W	hot water (as energy service) ^a
gl	glazing, glazed element	pl	layer	w	window
gn	gains	proc	processes	we	water evaporation
H	heating ^a	p	projected	zt	thermal zone
h	hourly	pl	plane, layer	ztc	thermally conditioned zone
hru	heat recovery unit	r	radiation, radiative	ztu	thermally unconditioned zone
HU	humidification ^a				

^a Type of energy use (energy service)

^b The subscript “e” is used for the term “external”, in contrast with “internal”. But if there is a risk of confusion between “external” to (for instance) a construction in general and “external”, meaning outdoor environment, then the term “outdoor” is recommended for the latter.

^c The subscript “int” is used for the term “internal”, in contrast with “external”. But if there is a risk of confusion between “internal” in a construction and “internal” in a building or thermal zone, then the term “indoor” is recommended for the latter.

NOTE In this document subscripts that are indexed (counting 1, 2, ...) can be found written in two ways:

- the comprehensive way: by adding an index (e.g. *i*) to the subscript, separated by a comma and written in italic. For instance “w,*i*”, for a variable related to a window, for window element *i*;
- the short way: as the subscript itself written in italic.

For instance: “*m*” is the monthly value of a variable, for the month *m*;

- this is short for “m,*i*”: the monthly value of a variable, for the month *i*.

Similarly, if there is no risk of confusion, it is also possible to write: “*w*” instead of “*w*,*i*”.

4.3 Abbreviations

For the purposes of this document, the abbreviations given in ISO 52000-1:2017, Clause 4 and Annex C and the following apply.

H	hourly calculation method
M	monthly calculation method
ZT	thermal zone

5 Description of the methods

5.1 Output of the method

This document covers the calculation of the energy need for heating and cooling and the internal temperature.

The method covers also the calculation of the design load for cooling, heating, humidification and dehumidification for a thermal zone and for a sub system.

For all calculations, the time interval is hourly.

Alternatively, for the calculation of the energy need for heating and cooling a monthly time interval can also be chosen.

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.

5.2 General description of the method

5.2.1 Hourly calculation procedures

The hourly calculation procedures in this document are derived from the reference calculation procedures as given in ISO 52017-1.

ISO 52017-1 provides a generic hourly calculation procedure, with only a minimum number of assumptions needed to define the energy balance equations, with no specific application, no specific solution technique and no specific input data.

The underlying document is an application of the method provided in ISO 52017-1. In function of the application, specific assumptions, simplifications, solution techniques and input data restrictions are provided in the underlying document.

NOTE 1 See ISO/TR 52016-2[1] for a more extensive explanation and justification.

With the hourly calculation method the thermal balance of the building or building thermal zone is made up at an hourly time interval.

The main goal of the hourly calculation method is to be able to take into account the influence of hourly and daily variations in weather, operation (solar blinds, thermostats, needs, occupation, accumulation, etc.) and their dynamic interactions for heating and cooling. The extra input for the user compared to the monthly calculation method is kept to a minimum.

In the hourly calculation method given in this document each construction element is modelled separately. This leads to transparency on the boundary conditions at either side of the constructions.

NOTE 2 For instance: heat transfer through the ground floor does not have to be lumped together with heat transfer through walls. Heat transfer through lightweight constructions does not have to be lumped together with heat transfer through heavy weight constructions. There is a clear distinction between air and mean radiation internal temperature, etc. These are important advantages compared to the simple hourly method in ISO 13790:2008.

The hourly climatic data are given in the relevant standard under EPB module M1-13 and the hourly and daily patterns of the conditions of use (operating schedules) are given in the relevant standard under EPB module M1-6. The hourly method produces also key monthly data that are essential for a quick understanding of the main processes involved and as a means to derive correction and adjustment factors for the monthly method.

The hourly calculation of the internal temperature, the energy need for heating and cooling and the calculation of the design heating and cooling load all use the same hourly internal temperature calculation. Although aim and outcome of these calculations are different, the calculation methods are identical and use the same inputs as far as possible.

Specific assumptions of the calculations may differ: for the calculation of design loads, the conditions of use and of climate of a design period apply.

For the calculation of design loads, distinction is made between a basic cooling/heating load calculation and a system specific cooling/heating load calculation.

For the basic cooling/heating load and energy need calculation, a continuous operation and no power restrictions for the cooling/heating system is assumed, and the emission is assumed to occur purely convective.

For the system specific cooling/heating load and energy need calculation, a limited operation time may be assumed, the available power of the system may be limited, the recoverable losses may be further specified and a convective fraction according to the system intended to be installed can be used.

5.2.2 Monthly calculation procedures

With the monthly calculation method the thermal balance of the building or building thermal zone is made up at a monthly time interval. The dynamic effects are taken into account by correction and adjustment factors.

These correction and adjustment factors can be developed on the basis of series of calculations using the hourly calculation procedures.

Because conditions of use and assumptions (e.g. on the amount of ventilation) may be different during days with heating needs and days with cooling needs, two independent calculations are done for each month: first the calculation of the energy need for heating, using the assumed conditions for heating and secondly the calculation of the energy need for cooling, using the assumed conditions for cooling.

NOTE 1 E.g. at national or regional level, to produce national or regional correction and adjustment factors replacing the informative default values from [Annex B](#) if needed.

NOTE 2 See more explanation, including justification and discussion of the limitations in the accompanying Technical Report, ISO/TR 52016-2[1].

5.2.3 Input data and assumptions for hourly and monthly method

The monthly calculation of the energy need for heating and cooling is based on the same assumptions and boundary conditions as the hourly calculation of the energy need for heating and cooling. Also the same inputs are used as far as possible, although averaged on monthly basis and where relevant corrected to approximate the impact of dynamic effects and dynamic interactions (e.g. recoverable heat

or cold from the technical building systems, control actions) that are not covered by the monthly time interval.

However, some input data are specific for either the hourly or the monthly calculation method of the energy need for heating and cooling. These differences are distinguished in this document in the tabulated overview of [6.3](#).

5.2.4 Choices between methods

5.2.4.1 Choice between hourly and monthly calculation method

[Table A.2](#) provides the normative template for the choice between the hourly or monthly calculation method, with an informative default choice in [Table B.2](#).

5.2.4.2 Choice between basic or system specific load calculation

The basic cooling/heating load calculation is used, when no specifications of the system intended to be installed are known or in simple cases when the usability of the system intended to be installed shall be evaluated. Simple cases are air heating and cooling systems or standard convector heaters and coolers.

The system specific cooling/heating load calculation is used in cases where the type and design of the system is advanced and the effects of a specific operation shall be evaluated.

For some systems like building component embedded systems the use of a system specific method may be compulsory, since the use of a basic load calculation may be misleading.

On the other hand, a system specific calculation may lead to too optimistic calculation results with regard of the calculated energy use, if the system is undersized and not capable to provide the assumed standard conditions of use.

6 Calculation method

6.1 Output data

6.1.1 General data on the assessed object and application

This document contains choices between different methods, input data or references. Several of these choices depend on the type of objects and/or type of building, and/or type of application and/or type of assessment.

General data on the assessed object and application are listed in [Table 2](#).

Table 2 — Output data of this method; general data on the assessed object

Description	Symbol	Intended destination module ^b	Comment ^a	See clause ^b
Number of thermal zones	$Z_{th,i}$	all	numbering of the thermal zones and which	H + M 6.4.2
List of spaces per thermal zone	$Z_{th,i} = S_k + S_l + S_m + \dots$	all	by space numbers	H + M: 6.4.2
^a Informative				
^b H: hourly calculation procedures, M: monthly calculation procedures				

Other general data on the assessed object and application are listed as input in 6.3.2. These data may also be needed as output for subsequent calculations, for instance in relevant system standards under EPB modules M3 to M7.

6.1.2 Calculated data

The geometrical output data are listed in Table 3.

The output data from the calculations are listed in Tables 4 to 10.

When relevant, the output data are given per thermal zone.

When relevant, the total output for the assessed object is obtained by the sum of the values over all thermal zones.

When relevant, the average output for the assessed object (building or part of the building) is obtained by averaging the values for all thermal zones, weighted according to the subdivision and recombination rules for thermal zones, as specified in ISO 52000-1:2017, 10.5.

The calculation method comprises different options. Therefore not all the output data are available in each case.

Table 3 — Output data: geometrical data, per thermal zone

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Useful floor area per thermal zone	$A_{use;zt}$	m ²	0 to ∞	All	NO	H + M: 6.4.3
Air volume per thermal zone	$V_{int;a;zt}$	m ³	0 to ∞	All	NO	H + M: 6.4.3
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

Be aware that the same variable as output can be the result of different assumptions (e.g. basic needs, system specific needs, absence of systems, design conditions, etc).

Table 4 — Output data: sensible heating and cooling loads and needs and internal temperatures

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Sensible energy need for heating, per thermally conditioned zone, per year	$Q_{H;nd;ztc;an}$	kWh	0 to ∞	M2-4, M3-4	Yes	H: 6.5.4.2 M: 6.6.4.2
Sensible energy need for cooling, per thermally conditioned zone, per year	$Q_{C;nd;ztc;an}$	kWh	0 to ∞	M2-4, M4-4	Yes	H: 6.5.4.2 M: 6.6.4.3
Sensible energy need for heating, per thermally conditioned zone, per month	$Q_{H;nd;ztc;m}$	kWh	0 to ∞	M3-5	Yes	H: 6.5.4.2 M: 6.6.4.2
Sensible energy need for cooling, per thermally conditioned zone, per month	$Q_{C;nd;ztc;m}$	kWh	0 to ∞	M4-5	Yes	H: 6.5.4.2 M: 6.6.4.3
Internal operative temperature, per thermally conditioned zone, per month	$\theta_{int;op;ztc;m}$	°C	0 to 50	M1-4, M3-5, M4-5, M5-5, M8-5, M3 to M8	Yes	H: 6.5.5.3 e M: 6.6.11.6
Internal temperature, per thermally unconditioned zone, per month	$\theta_{ztu;m}$	°C	-20 to 50	M3 to M8	Yes	H: 6.4.5.3 e M: 6.4.5.3
(Sensible) hourly heating load, per thermally conditioned zone, per hour	$\Phi_{H;ld;ztc;t}$	W	0 to ∞	M3-5	Yes	H: 6.5.5.2 M: n. a.
(Sensible) hourly cooling load, per thermally conditioned zone	$\Phi_{C;ld;ztc;t}$	W	0 to ∞	M4-5	Yes	H: 6.5.5.2 M: n. a.
Internal operative temperature, per thermally conditioned zone, per hour	$\theta_{int;op;ztc;t}$	°C	0 to 50	M1-4, M3-5, M4-5, M5-5, M8-5	Yes	H: 6.5.5.3 M: n. a.
Internal mean radiant temperature, per thermally conditioned zone, per hour	$\theta_{int;r;mn;ztc;t}$	°C	0 to 50	same	Yes	H: 6.5.5.3 M: n. a.
Indoor air temperature, per thermally conditioned zone, per hour	$\theta_{int;a;ztc;t}$	°C	0 to 50	same	Yes	H: 6.5.5.4 M: n. a.
Internal temperature, per thermally unconditioned zone, per hour	$\theta_{ztu;t}$	°C	-20 to 50	M3 to M8	Yes	H: 6.4.5.3 e M: n.a.
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Average of hourly values						

Table 5 — Output data: Latent energy loads and needs and internal moisture content

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Humidification needs, per thermally conditioned zone, per year	$Q_{HU;nd;zt;an}$	kWh	0 to ∞	M2-4, M6-4	Yes	H: 6.5.4.3 M: 6.6.14
Dehumidification needs, per thermally conditioned zone, per year	$Q_{DHU;nd;zt;an}$	kWh	0 to ∞	M2-4, M7-4	Yes	H: 6.5.4.3 M: 6.6.14
Humidification needs, per thermally conditioned zone, per month	$Q_{HU;nd;zt;m}$	kWh	0 to ∞	(M6-5)	Yes	H: 6.5.4.3 M: 6.6.14
Dehumidification needs, per thermally conditioned zone, per month	$Q_{DHU;nd;zt;m}$	kWh	0 to ∞	(M7-5)	Yes	H: 6.5.4.3 M: 6.6.14
Humidification moisture load, per thermally conditioned zone, per hour	$G_{HU;ld;zt;t}$	kg/s	0 to ∞	M6-5	Yes	H: 6.5.14 M: n. a.
Dehumidification moisture (removal) load, per thermally conditioned zone, per hour	$G_{DHU;ld;zt;t}$	kg/s	0 to ∞	M7-5	Yes	H: 6.5.14 M: n. a.
Latent heat load for humidification (humidification load), per thermally conditioned zone, per hour	$\Phi_{HU;ld;zt;t}$	W	0 to ∞	M4-5 (combined with sensible heat load)	Yes	H: 6.5.14 M: n. a.
Latent heat load for dehumidification (dehumidification load), per thermally conditioned zone, per hour	$\Phi_{DHU;ld;zt;t}$	W	0 to ∞	M4-5 (combined with sensible heat load)	Yes	H: 6.5.14 M: n. a.
Required moisture content for central humidification of the mechanical supply air, per thermally conditioned zone, per hour	$x_{a;sup;HU;req;zt;t}$	kg/kg dry air	0 to 0,050	M5-6	Yes	H: 6.5.14 M: n. a.
Required moisture content for central dehumidification of the mechanical supply air, per thermally conditioned zone, per hour	$x_{a;sup;DHU;req;zt;t}$	kg/kg dry air	0 to 0,050	M5-6	Yes	H: 6.5.14 M: n. a.
Indoor moisture content, per thermally conditioned zone, per hour	$x_{int;a;zt;t}$	kg/kg dry air	0 to 0,050	M5-6	Yes	H: 6.5.14 M: n. a.
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

Table 6 — Output data: dynamic control

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Dynamic control output						
Actual hourly on/off pattern window shutters over the year	..	-	..	-	Yes	H: Annex G
Actual hourly on/off pattern solar shading provisions over the year	..	-	..	M9	Yes	H: Annex G
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

Table 7 — Output data: design (sensible and latent) heating and cooling load calculation

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Design sensible heating load, per year	$\Phi_{H;ld;des;ztc;an}$	W	0 to ∞	(M4)	Yes	H: 6.5.4.5 M: n. a.
Design sensible cooling load, per year	$\Phi_{C;ld;des;ztc;an}$	W	0 to ∞	(M5)	Yes	H: 6.5.4.5 M: n. a.
Design humidification moisture load, per year	$G_{HU;ld;des;ztc;an}$	kg/s	0 to ∞	(M6)	Yes	H: 6.5.4.5 M: n. a.
Design dehumidification moisture load, per year	$G_{DHU;ld;des;ztcan}$	kg/s	0 to ∞	(M7)	Yes	H: 6.5.4.5 M: n. a.
Design latent heat load for humidification, per year	$\Phi_{HU;ld;des;ztc;an}$	W	0 to ∞	(M6)	Yes	H: 6.5.4.5 M: n. a.
Design latent heat load for dehumidification, per year	$\Phi_{DHU;ld;des;zt;anc}$	W	0 to ∞	(M7)	Yes	H: 6.5.4.5 M: n. a.
Design increase of the supply air moisture content, compared to the moisture content of external air, for humidification, per year	$\Delta x_{a;-sup;HU;ld;des;ztc;an}$	kg / kg dry air	0 to 20	(M6)	No	H: 6.5.4.5 M: n.a.
Design decrease of the supply air moisture content, compared to the moisture content of external air, for dehumidification, per year	$\Delta x_{a;sup;D-HU;ld;des;ztc;an}$	kg / kg dry air	0 to 20	(M7)	No	H: 6.5.4.5 M: n.a.
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

Table 8 — Output data: Hourly calculation procedures, indicators for system undersizing

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Annual amount of under-sizing of the heating system for different thresholds $\Phi_{UH;ld;thres,l}$	$Q_{UH;thres,i,ztc;an}$	kWh	0 to ∞	M1-4, M2-4	No	H: 6.5.15 M: 6.6.4 .
Annual amount of under-sizing of the cooling system for different thresholds $\Phi_{UC;ld;thres,l}$	$Q_{UC;thres,i,ztc;an}$	kWh	0 to ∞	M1-4, M2-4	No	H: 6.5.15 M: 6.6.4 .
Annual accumulated undertemperature (“underheating”) for different temperature differences $\Delta\theta_{UH;thres,i}$	$T_{UH;thres,i,ztc;an}$	K·h	0 to ∞	M1-4, M2-4	No	H: 6.5.15 M: 6.6.4
Annual accumulated over-temperature for different temperature differences $\Delta\theta_{OH;thres,i}$	$T_{OH;thres,i,ztc;an}$	K·h	0 to ∞	M1-4, M2-4	No	H: 6.5.15 M: 6.6.4
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

Table 9 — Output data: hourly calculation procedures, key monthly data

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
Monthly heat balance ratio, heating	$\gamma_{H;gn;ztc;m}$	-	$-\infty$ to ∞	(M2-2)	Yes	H: 6.5.15
Monthly heat balance ratio, cooling	$\gamma_{C;ht;ztc;m}$	-	$-\infty$ to ∞	(M2-2)	Yes	H: 6.5.15
Monthly utilization factor, heating	$\eta_{H;gn;ztc;m}$	-	-1 to 1	(M2-2)	Yes	H: 6.5.15
Monthly utilization factor, cooling	$\eta_{C;ht;ztc;m}$	-	-1 to 1	(M2-2)	Yes	H: 6.5.15
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures NOTE These output data are intended to be used for a quick understanding of the main processes involved and as a means to derive correction and adjustment factors for the monthly method						

Table 10 — Output data: design loads per subsystem

Description	Symbol	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c	See clause ^d
(annual) design sensible heating load in the subsystem	$\Phi_{H;ld;des;ss;an}$	W	0 to ∞	(M3-5)	Yes	H: 6.5.4.5 M: n. a.
(annual) design sensible cooling load in the subsystem	$\Phi_{C;ld;desint;a;ss;an}$	W	0 to ∞	(M4-5)	Yes	H: 6.5.4.5 M: n. a.
^a Practical range, informative ^b Informative ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

6.2 Calculation time intervals and calculation period

The methods described in paragraph [6.5](#) are suitable for an hourly time interval. The methods described in [6.6](#) have a monthly time interval.

The calculation period is a full year, except for the application for peak indoor temperatures and design loads, which are calculated over a short representative period.

The length of the heating or cooling or (de-)humidification season is defined by the operation time of the respective technical systems. This has to be taken into account in the system specific calculations. It may differ from the time resulting from the basic energy needs calculation. See [6.5.2](#) and [6.6.2](#).

6.3 Input data

6.3.1 Source of data; general

In this document the input data is given for the calculation of the energy load and need for heating and cooling, the calculation of the internal temperature and the calculation of the design heating and cooling load.

This document comprises different options. Therefore not all the input data are necessary in each case.

The source of data for the calculation procedure in this document may depend on the (supposed) availability of input data. For instance, in case of existing buildings with limited information on the products and/or on the composition of building element assemblies, the level and type of input data might differ from new buildings. The selection which source applies may be done at national or regional level when the set of EPB standards is used in the context of national or regional building regulations. Where relevant, [Annex A](#) provides the template for the choices, values and references, with informative default choices, values and references in [Annex B](#).

ISO 52000-1:2017, Clause 9, contains the rules for the distribution of heat flows in case of differences in the division of the various types of zones.

EXAMPLE From a thermal zone to the lighting zones and vice versa.

6.3.2 General data on the assessed object and application

This document contains choices between different methods, input data and/or references. Several of these choices depend on the type of object, type of building or space, type of application or type of assessment.

Consequently, for the correct use of this document and for the overall consistency of the energy performance assessment, the general data about the assessed object in [Table 11](#), obtained from ISO 52000-1:2017, 6.3.2, are needed as input to this document:

Table 11 — General data on the assessed object and application

Description	Identifier	Unit	Source
Object type (more than one choice possible)	EPB_OBJECT_TYPE	n/a	ISO 52000-1
Building category	BLDNGCAT_TYPE	n/a	ISO 52000-1
Space category for each space or group of spaces (if different from building category)	SPACECAT_TYPE	n/a	ISO 52000-1
Application type	EPB_APPLIC_TYPE	n/a	ISO 52000-1
Assessment type	EPB_ASSESS_TYPE	n/a	ISO 52000-1
Calculation case	CASE_IDENTIFIER	n/a	ISO 52000-1

NOTE ISO 52000-1:2017, Tables A.2 to A.7 (normative template, with informative default lists in Tables B.2 to B.7) contain limited lists of possible types. These lists are respected in all subsequent EPB standards. National or regional lists can be specified in a national data sheet replacing Tables B.2 to B.7, in line with the template of ISO 52000-1:2017, Tables A.2 to A.7.

6.3.3 Geometrical characteristics

The required geometrical data are listed in [Table 12](#).

Table 12 — Geometrical data list

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d
Geometrical data						
Useful floor area per elementary space	$A_{use;sp}$	m ²	0 to ∞	Local	No	H+M
Air volume per elementary space	$V_{int;a;sp}$	m ³	0 to ∞	Local	No	H+M
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures						

The geometrical input data for building elements are listed as part of the thermophysical parameters in [6.3.4](#).

NOTE The chosen metric for the geometrical data (area, length) can have an effect on the thermophysical properties (per unit of area or length).

6.3.4 Thermophysical parameters of the building and building elements

The required technical data on the level of the thermal zones are listed in [Table 13](#).

[Table 14](#) contains the input data list related to the building elements.

Input data list related to external solar shading are listed in [Table 15](#).

This document comprises different options. Therefore not all the data in these tables are necessary in each case.

NOTE 1 If data are a mix of thermophysical data and boundary conditions (such as the virtual ground temperature), they are also listed in these tables.

NOTE 2 When there is a choice, the default choice given in [Annex B](#) is used as basis.

Table 13 — Thermal zone related input data list

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Value of areal thermal capacity of air and furniture per thermally conditioned zone	$\kappa_{m,int}$	J/(m ² ·K)	Identifier	Local or default (Table A.17)	No	H	-
Class of the internal heat capacity per thermally conditioned zone	-	-	Identifier	Local	No	M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures							

Table 14 — Building element related input data list

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Hourly calculation procedures:							
Thermal resistance, per opaque building element	$R_{c;k}$	(m ² ·K)/W	0 to 10	M2-5.1	No	H	R_c
Effective thermal resistance, per building element in thermal contact with the ground, including slab-on-ground floors, suspended floors and basements (including the effect of the ground)	$R_{c,fl;eff;k}$	(m ² ·K)/W	0 to 10	M2-5.1	No	H	$R_{f;eff}$
Thermal resistance of a 0,5 m thick ground layer, per building element in thermal contact with the ground	$R_{gr;k}$	(m ² ·K)/W	0 to 10	M2-5.1	No	H	R_g
Thermal capacity of a 0,5 m thick ground layer, per building element in thermal contact with the ground	$\kappa_{gr;k}$	J/(m ² ·K)	≥ 0	M2-5.1	No	H	κ_g
Thermal resistance of a virtual ground layer, per building element in thermal contact with the ground	$R_{gr;vi;k}$	(m ² ·K)/W	0 to 10	M2-5.1	No	H	$R_{g,v}$
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures							

Table 14 (continued)

Name	Symbol	Unit	Validity inter- val ^a	Origin ^b	Vary- ing ^c	Calculation method ^d	Symbol in origin (if different)
Virtual ground temperature, per building element in thermal contact with the ground, per month	$\theta_{gr;vi;k;m}$	°C	-50 to +50	M2-5.1	No	H	$\theta_{g;ve;m}$
Convective heat transfer coefficient internal surface, per construction element	$h_{ci;k}$	W/(m ² ·K)	0 to 50	M2-5.1	No	H	h_{ci}
Long-wave radiative heat transfer coefficient internal surface, per construction element	$h_{ri;k}$	W/(m ² ·K)	0 to 50	M2-5.1	No	H	h_{ri}
Class for the distribution of the mass, per opaque building element	-	-	Identifier	Local	No	H	-
Class for the areal heat capacity, per opaque element	-	-	Identifier	Local	No	H	-
Monthly calculation procedures:							
Thermal transmittance, per opaque element	$U_{c;op;k}$	W/(m ² ·K)	0 to 10	M2-5.1	No	M	U_c
Ground transmission heat transfer coefficient for building elements in thermal contact with the ground, including slab-on-ground floors, suspended floors and basements, per thermal zone and month, based on the annual temperature difference	$H_{gr;an;ztc;m}$	W/K	0 to ∞	M2-5.1	Yes	M	$H_{g;an;m}$
Average overall heat transfer coefficient for transmission through the ground floor, adjusted for the seasonal temperature difference, for the heating season, per thermal zone	$H_{gr;H;adj;ztc}$	W/K	0 to ∞	M2-5.1	No	M	$H_{g;H;adj}$
Average overall heat transfer coefficient for transmission through the ground floor, adjusted for the seasonal temperature difference, for the cooling season, per thermal zone	$H_{gr;C;adj;ztc}$	W/K	0 to ∞	M2-5.1	No	M	$H_{g;C;adj}$
Hourly and monthly calculation procedures:							
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures							

Table 14 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Area, per construction element; in case of protruded components also the projected area	$A_{el;k}$	m ²	0 to ∞	M2-5.1	No	H+M	A_e
Convective heat transfer coefficient external surface, per construction element	$h_{ce;k}$	W/(m ² ·K)	0 to 50	M2-5.1	No	H+M	h_{ce}
Long-wave radiative heat transfer coefficient external surface, per construction element	$h_{re;k}$	W/(m ² ·K)	0 to 50	M2-5.1	No	H+M	h_{re}
Thermal transmittance, per window	$U_{w;k}$	W/(m ² ·K)	0 to 10	M2-5.1	No	H+M	U_w
Thermal transmittance, per window with closed shutter	$U_{wsht;k}$	W/(m ² ·K)	0 to 10	M2-5.1	No	H+M	U_{ws}
Thermal transmittance, per door	$U_{d;k}$	W/(m ² ·K)	0 to 10	M2-5.1	No	H+M	U_d
Thermal transmittance, per curtain wall	$U_{cw;k}$	W/(m ² ·K)	0 to 10	M2-5.1	No	H+M	U_{cw}
Glazed area, per window element	$A_{gl;k}$	m ²	0 to ∞	M2-5.1	No	H+M	A_g
Linear thermal transmittance, per linear thermal bridge	$\psi_{tb;k}$	W/(m·K)	0 to 10	M2-5.1	No	H+M	ψ
Length, per linear thermal bridge	$l_{tb;k}$	m	0 to ∞	M2-5.1	No	H+M	l
Overall heat transfer coefficient for the thermal bridges, per thermal zone	$H_{tr,tb;zt}$	W/K	0 to ∞	M2-5.1	Yes	H+M	H_{tb}
Heat transfer coefficient between thermally conditioned zone and thermally unconditioned zone, per month	$H_{ztc,j;ztu;m}$	W/K	0 to ∞	M2-5.1	Yes	H+M	H_{iu}
Heat transfer coefficient between thermally unconditioned zone ztu and external environment, per month	$H_{ztu;e;m}$	W/K	0 to ∞	M2-5.1	Yes	H+M	H_{ue}
Heat transfer coefficient between thermally unconditioned zone ztu and external environment by transmission, per month	$H_{tr;ztu;e;m}$	W/K	0 to ∞	M2-5.1	Yes	H+M	$H_{tr;ue}$
Tilt angle, per external building element (from horizontal, measured upwards facing)	$\beta_{ic;k}$	°	0 to 180	Local	No	H+M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures							

Table 14 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Orientation angle per external building element, (expressed as the geographical azimuth angle of the horizontal projection of the inclined surface normal; convention: angle from South, eastwards positive, westwards negative)	$\gamma_{ic;k}$	°	-180 to +180	Local	No	H+M	
Class for the solar absorption coefficient of the external surface, per opaque element	$a_{sol;k}$	-	0 to 1	Local or default (Table A.15 (H) or Table A.29 (M))	No	H+M	
Total solar energy transmittance at normal incidence, for the transparent part, per transparent building element with non-scattering glazing	$g_{gl;n;k}$	-	0 to 1	M2-8 ([3] of Table C.1)	No	H+M	g_n
Total solar energy transmittance at 45 degrees ($x=45$) incidence and diffuse ($x = dif$) radiation, for the transparent part, per transparent building element with scattering glazing or blinds	$g_{gl;x;k}$	-	0 to 1	M2-8 ISO 15099(or see Subject 4 in Table C.1)	No	H+M	g_t
Total solar energy transmittance including solar protection device of the transparent part, per transparent building element	$g_{gl;sh;k}$	-	0 to 1	M2-8 ISO 52022-3 or ISO 15099(or see Subject 5 in Table C.1)	No	H+M	g_t
Calculation method based on thermally coupled thermal zones							
Heat transfer coefficient by transmission between zones z and y	$H_{tr,zy}$	W/K	0 to ∞	M2-2	No	H+M	
Ventilation heat transfer coefficient from zone z to zone y	$H_{ve,z \rightarrow y}$	W/K	0 to ∞	M2-2	No	H+M	
Ventilation heat transfer coefficient from zone y to zone z	$H_{ve,y \rightarrow z}$	W/K	0 to ∞	M2-2	No	H+M	
Dynamic transparent building elements							
Thermal transmittance, per dynamic window or façade, per state	$U_{dyn;k,i}$	W/(m ² ·K)	0 to 10	M2-5 (see Annex G)	Yes	H+M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures							

Table 14 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Total solar energy transmittance, per dynamic window or façade, per state i	$g_{\text{dyn};k;i}$	-	0 to 1	M2-8 (see Annex G)	Yes	H+M	
Solar transmittance, per dynamic window or façade, per state	$\tau_{\text{sol}; \text{dyn};k;i}$	-	0 to 1	M2-8 (see Annex G)	Yes	H+M	
Visual transmittance, per dynamic window or façade, per state	$\tau_{\text{vis}; \text{dyn};k;i}$	-	0 to 1	M2-8 (see Annex G)	Yes	H+M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures							

Table 15 — Input data list related to external solar shading

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Latitude of the weather station	φ_w	°	-90 to +90	M1-13	No	M	
Base height, per shaded surface, from ground level	$H_{0;ic;k}$	m	≥ 0	Local	No	H+M	
Height, per shaded surface, from bottom to top; if tilted: vertical projection ^e	$H_{ic;k}$	m	> 0	Local	No	H+M	
Width, per shaded surface	$W_{ic;k}$	m	≥ 0	Local	No	H+M	
Tilt angle, per external building element (from horizontal, measured upwards facing) ^e	$\beta_{ic;k}$	°	0 to 180	Local	No	H+M	
Orientation angle per external building element, (expressed as the geographical azimuth angle of the horizontal projection of the inclined surface normal; convention: angle from South, eastwards positive, westwards negative) ^e	$\gamma_{ic;k}$	°	-180 to +180	Local	No	H+M	
Depth of a (simple) overhang (or similar shading object)	$D_{k;ovh,q}$	m	≥ 0	Local	No	H+M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Could already have been covered as input data per (opaque or transparent) building element							

Table 15 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Vertical distance between the edge of the façade element and a (simple) overhang (or similar shading object)	$L_{k;ovh,q}$	m	≥ 0	Local	No	H+M	
Depth of a (simple) right side fin (or similar shading object)	$D_{k;finr,r}$	m	≥ 0	Local	No	H+M	
Horizontal distance between the edge of the façade element and a (simple) right side fin (or similar shading object)	$L_{k;finr,r}$	m	≥ 0	Local	No	H+M	
Depth of a (simple) left side fin (or similar shading object)	$D_{k;finl,l}$	m	≥ 0	Local	No	H+M	
Horizontal distance between the edge of the façade element and a (simple) left side fin (or similar shading object)	$L_{k;finl,l}$	m	≥ 0	Local	No	H+M	
Height from ground level, per shading obstacle in a skyline segment	$H_{k;obst;p,i}$	m	≥ 0	Local	No	H+M	
Horizontal distance between the shaded surface k and the shading object (obstacle) in a skyline segment, per shading object, measured between their central points	$L_{k;obst;p,i}$	m	≥ 0	Local	No	H+M	
Lowest height, from ground level, per shading overhang in a skyline segment, from ground level	$H_{k;ovh;q,i}$	m	≥ 0	Local	No	H+M	
Horizontal distance between the shaded surface k and the overhang in a skyline segment, per shading object, measured between their central points	$L_{k;ovh;q,i}$	m	≥ 0	Local	No	H+M	
Position, per skyline segment, indicated by the upper boundary of the geographical azimuth angle (convention: angle from South, eastwards positive, westwards negative)	$\gamma_{sh;obst;max;i}$	°	-180 to + 180	Local	No	H+M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Could already have been covered as input data per (opaque or transparent) building element							

6.3.5 Operating and boundary conditions

Required operating and boundary conditions data for this calculation procedure are listed in [Tables 16-18](#)

Specific adaptations may be needed in case of hourly calculation of the internal temperature under design summer conditions (see 6.5.4.4) or hourly calculation of design heating, cooling or latent heat loads (see 6.5.4.5).

This document comprises different options. Therefore not all the data in these tables are necessary in each case.

NOTE When there is a choice, the default choice given in Annex B is used as basis.

Table 16 — Input data related to conditions of use and technical building systems

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Hourly calculation procedures^e:							
Temperature set-point for heating, per thermally conditioned zone, per hour, taking into account intermittent heating (day, night, weekend) and unoccupied periods, if applicable	$\theta_{\text{int;set;H;zt};t}$	°C	0 to 50	M1-6	Yes	H	
Temperature set-point for cooling, per thermally conditioned zone, per hour, taking into account intermittent cooling (e.g. weekend) and unoccupied periods, if applicable	$\theta_{\text{int;set;C;zt};t}$	°C	0 to 50	M1-6	Yes	H	
Available heating power, per thermally conditioned zone, per hour	$\Phi_{\text{H;avail;zt};t}$	W	0 to ∞	M3-1	Yes	H	
Available cooling power, per thermally conditioned zone, per hour	$\Phi_{\text{C;avail;zt};t}$	W	0 to ∞	M4-1	Yes	H	$Q_{\text{C;out;zt};j}$
Convective fraction of the heating system per thermally conditioned zone (if system specific)	$f_{\text{H,c ztc}}$	-	0 to 1	(M3-5 or M3 system description) or default (Table A.11)	No	H	
Convective fraction of the cooling system per thermally conditioned zone (if system specific)	$f_{\text{C,c ztc}}$	-	0 to 1	(M4-5 or M4 system description) or default (Table A.11)	No	H	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							

Table 16 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Set-point relative humidity for humidification, per thermally conditioned zone, per hour	$\varphi_{\text{int;set;HU;zt};t}$	%	0 to 100	M1-6	Yes	H	
Set-point relative humidity for dehumidification, per thermally conditioned zone, per hour	$\varphi_{\text{int;set;DHU;zt};t}$	%	0 to 100	M1-6	Yes	H	
Volume flow rate for each air flow element k entering a thermal zone, per hour	$q_{V,k;t}$	m ³ /s	0 to ∞	M5-5	Yes	H	$q_{V;\text{arg};\text{in}}$ $q_{V;\text{comb};\text{in}}$ $q_{V;\text{lea};\text{in}}$ $q_{V;\text{pdu};\text{in}}$ $q_{V;\text{vent};\text{in}}$
Supply temperature for each ventilation system air flow element k entering a zone, per hour	$\theta_{\text{sup};k;t}$	°C	0 to 50	M5-5	Yes	H	
Supply air moisture content for air flow element k entering a thermal zone, per hour	$x_{a;\text{sup};k;t}$	kg/kg dry air	0 to 1	M5-5	Yes	H	
Actual system specific moisture content of the mechanical supply air entering a zone, in case of central (de-)humidification of the mechanical ventilation, per thermally conditioned zone, per hour	$x_{a;\text{sup};\text{ss};\text{zt};t}$	kg/kg dry air	0 to ∞	M5-6	Yes	H	
Actual system specific moisture supply by the local system for humidification, per thermally conditioned zone, per hour	$G_{\text{HU};\text{ss};\text{zt};t}$	kg/s	0 to ∞	M6-5	Yes	H	
Actual system specific moisture removal by the local system for dehumidification, per thermally conditioned zone, per hour	$G_{\text{DHU};\text{ss};\text{zt};t}$	kg/s	0 to ∞	M7-5	Yes	H	
Monthly calculation procedures:							
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							

Table 16 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
The normal ('thermal comfort level') heating temperature set-point per thermally conditioned zone	$\theta_{\text{int;set;H;ztc}}$	°C	0 to 50	M1-6	No	M	
The reduced ('economy level') heating temperature set-point of the zone (day, night and/or weekend)	$\theta_{\text{int;set;H;low;ztc}}$	°C	0 to 50	M1-6	No	M	
The duration of the period with reduced heating set-point (day, night and/or weekend)	$\Delta t_{\text{H;red;y;ztc}}$	h	0 to 48	M1-6	No	M	
The number of repetitions in a week of heating reduction period (day, night and/or weekend)	$n_{\text{rep;H;red;y;ztc}}$	-	0 to 7	M1-6	No	M	
The normal ('thermal comfort level') cooling temperature set-point per thermally conditioned zone	$\theta_{\text{int;set;C;ztc}}$	°C	0 to 50	M1-6	No	M	
The number of hours during the weekend with reduced temperature set-point for cooling or interruption	$\Delta t_{\text{C;red;wknd;ztc}}$	-	0 to 48	M1-6	No	M	
The fraction of the month which is the unoccupied (heating/cooling) period	$f_{\text{H/C;nocc;ztc;m}}$	-	0 to 1	Local	Yes	M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or "local" (type, geometry) ^c "Varying": value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							

Table 16 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Monthly time-average airflow rate of air flow element, k entering the thermal zone, for heating/cooling, for each month	$q_{V;k;H/C;m}$	m ³ /s	0 to ∞	M5-5	Yes	M	
Monthly mean supply temperature for each ventilation system air flow element, for heating/cooling, entering a zone, for each month	$\theta_{sup;k;H/C;m}$	°C	0 to 50	M5-2	Yes	M	
The fraction of sensible energy need to be added for dehumidification, per type of cooling system	$f_{DHU;C;ss}$	-	0 to 1	M7-5	No	M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							

Table 17 — Climatic input data

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Hourly calculation procedures:							
External (outdoor) air temperature at each hour	$\theta_{e;a;t}$	°C	-50 to +50	M1-13	Yes	H	θ_a
Moisture content or mixing ratio of the external air per hour	$x_{a;e;t}$	kg/kg dry air	0 to ∞	M1-13	Yes	H	x
Direct part (including circumsolar) of the solar irradiance, per building element, per hour	$I_{sol;dir;tot;k;t}$	W/m ²	0 to ∞	M1-13	Yes	H	$I_{dir;tot}$
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							

Table 17 (continued)

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Diffuse part (excluding circumsolar; including ground reflection) of the solar irradiance, per building element, per hour	$I_{sol;dif;tot;k;t}$	W/m ²	0 to ∞ 0 to ∞	M1-13	Yes	H	$I_{dif;tot}$
Solar altitude angle, from horizontal, per hour	$\alpha_{sol;t}$	°	0 to 90	M1-13	Yes	H	
Solar azimuth angle, per hour (Convention in this document: angle from South, eastwards positive, westwards negative)	$\varphi_{sol;t}$	°	-180 to +180	M1-13	Yes	H	
Monthly calculation procedures:							
Duration, per month	Δt_m	h	672 to 744	M1-13	Yes	M	-
Mean external (outdoor) air temperature, per month	$\theta_{e;a;m}$	°C	-50 to +50	M1-13	Yes	M	$\theta_{a;m}$
Mean external (outdoor) air temperature, per year	$\theta_{e;a;an}$	°C	-50 to +50	M1-13	No	M	$\theta_{a;an}$
Total solar irradiation per building element, per month	$H_{sol;k;m}$	kWh/m ²	0 to ∞	M1-13	Yes	M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							

Table 18 — Internal heat gains including recoverable heat losses and moisture production

Name	Symbol	Unit	Validity interval ^a	Origin ^{b,e}	Varying ^c	Calculation method ^d	Symbol in origin (if different)
Hourly calculation procedures:							
Specific internal heat flow rate due to occupants, per thermal zone, per hour	$q_{\text{int};\text{oc};z;t}$	W/m ²	0 to ∞	M1-6	Yes	H	
Specific internal heat flow rate due to appliances, per thermal zone, per hour	$q_{\text{int};\text{A};z;t}$	W/m ²	0 to ∞	M1-6	Yes	H	
Specific internal heat flow rate due to lighting, per thermal zone, per hour	$q_{\text{int};\text{L};z;t}$	W/m ²	0 to ∞	M9-1	Yes	H	
Specific internal heat flow rate due to hot and mains water and sewage systems, per thermal zone, per hour	$q_{\text{int};\text{WA};z;t}$	W/m ²	0 to ∞	M3-1 and M8-1	Yes	H	Incl. in M3-1
Specific internal heat flow rate due to HVAC, per thermal zone, per hour	$q_{\text{int};\text{HVAC};z;t}$	W/m ²	0 to ∞	M3-1, M4-1 and M5-1	Yes	H	$Q_{\text{HZ};\text{ls};\text{rbl}}$ $Q_{\text{C};\text{sto};\text{ls};-\text{tot};\text{rbl}}$ $Q_{\text{V};\text{ls};\text{dis};\text{rbl};z;t;i}$ $Q_{\text{V};\text{ls};\text{gen};\text{rbl}}$
Specific internal heat flow rate due to processes and goods, per thermal zone, per hour	$q_{\text{int};\text{proc};z;t}$	W/m ²	0 to ∞	M1-6	Yes	H	
Moisture production in the zone, per thermally conditioned zone, per hour	$G_{\text{int};z;t}$	kg/s	0 to ∞	M1-6	Yes	H	
Monthly calculation procedures:							
Specific internal heat gain due to occupants, for heating/cooling, per thermal zone, per month	$Q_{\text{H/C};\text{spec};\text{int};\text{oc};z;-t;m}$	W/m ²	0 to ∞	M1-6	Yes	M	
Specific internal heat gain due to appliances, for heating/cooling, per thermal zone, per month	$Q_{\text{H/C};\text{spec};\text{int};\text{A};z;-t;m}$	W/m ²	0 to ∞	M1-6	Yes	M	
^a Practical range, informative ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry) ^c “Varying”: value can vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year) ^d H: hourly calculation procedures, M: monthly calculation procedures ^e Some of the conditions of use can be adapted by system specific input							