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

**Part 3:  
Calculation procedures regarding  
adaptive building envelope elements**

*Performance énergétique des bâtiments — Besoins d'énergie pour  
le chauffage et le refroidissement, les températures intérieures et les  
chaleurs sensible et latente —*

*Partie 3: Méthodes de calcul des éléments adaptables de l'enveloppe  
du bâtiment*

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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 document 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by ISO 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 the parts in the ISO 52016 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

This document, along with other international standards, assesses the overall energy performance of buildings (EPB). Throughout this document, this group of standards is referred to as the “set of EPB standards”. A list of the standards in this set can be found on the [EPB Center website](#).<sup>1)</sup>

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.

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

Further target groups are parties who want to motivate their assumptions by classifying the EPB for a dedicated building stock.

This document is also important for manufacturers and suppliers of adaptive building envelope elements.

Background information, including justification, explanation and demonstration of the calculation procedures in this document, is provided in ISO/TR 52016-4<sup>2)</sup>.

The subset of EPB standards prepared under the responsibility of ISO/TC 163/SC 2 cover inter alia:

- calculation procedures on the overall energy use and EPB;
- 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;
- 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 Technical Committees for the details on, for example, appliances, technical building systems and indoor environment.

This document presents procedures for taking into account the effect of adaptive building envelope elements in the calculation of the energy needs for heating and cooling, internal temperatures and sensible and latent heat loads according to ISO 52016-1.

This document takes precedence if there is a conflict with any provision in ISO 52016-1.

NOTE 1 For instance some of the simplified calculation procedures in ISO 52016-1:2017, Annex G, *Dynamic transparent building elements*, are in conflict with the more refined procedures in this document.

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).

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1) <https://epb.center/support/documents>.

2) Under preparation. Stage at the time of publication: ISO/WD TR 52016-4.

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[Z] 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 under preparation.

NOTE 3 The modules in Tables A.1 and B.1 represent EPB standards, although one EPB standard can cover more than one module and one module can be covered by more than one EPB standard, for instance a simplified and a detailed method respectively.

**Table 1 — Position of this document (in casu M2-2 and M2-3), within the modular structure of the set of EPB standards**

Submodule	Overarching		Building (as such)		Technical building systems									
	Descriptions		Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot water	Lighting	Building automation and control	e.g. 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	ISO 52016-3 (this document)	Needs								a	
3	Applications		(Free) Indoor conditions without systems	ISO 52016-3 (this document)	Maximum load and power									
4	Ways to express energy performance		Ways to express energy performance		Ways to express energy performance									
5	Building categories and building boundaries		Heat transfer by transmission		Emission and control									
6	Building occupancy and operating conditions		Heat transfer by infiltration and ventilation		Distribution and control									

<sup>a</sup> The shaded modules are not applicable.

**Table 1 (continued)**

Submodule	Overarching		Building (as such)		Technical building systems									
	Descriptions		Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot water	Lighting	Building automation and control	e.g. PV, wind
sub1		M1		M2		M3	M4	M5	M6	M7	M8	M9	M10	M11
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													

<sup>a</sup> 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 3: Calculation procedures regarding adaptive building envelope elements

### 1 Scope

This document specifies procedures for the calculation of the energy needs for heating and cooling, internal temperatures and sensible and latent heat loads of a building according to the hourly calculation methodology in ISO 52016-1. Additions or modifications of the calculations are provided in this document if the building envelope contains one or more adaptive building envelope elements (building envelope elements with adaptive components that are either environmentally or actively controlled as a function of specific conditions). The adaptive building envelope element replaces the transparent building element in the calculation according to ISO 52016-1.

The three types of adaptive building envelope elements covered in this document are:

- building envelope elements with dynamic solar shading;
- building envelope elements with chromogenic glazing;
- building envelope elements with an actively ventilated cavity.

Environmentally activated control is described for building envelope elements with chromogenic glazing, but can also occur for other types of adaptive building envelope elements. In that case the same approach applies as for environmentally activated chromogenic glazing.

This document is applicable to the assessment of the energy performance of buildings (EPB) (energy performance labels and certificates), including comparison between buildings and checking conformity with minimum energy performance criteria.

It is also applicable to assess the contribution of the adaptive building envelope element to the smart readiness of a building.

In addition, this document provides indicators for the impact of the adaptive building envelope element on the performance of the building compared to a reference building envelope element. It is applicable to buildings at the design stage, to new buildings after construction and to existing buildings in the use phase.

This document is not applicable to geometrically complex adaptive building envelope elements that can only be modelled as multiple coupled thermal zones.

NOTE The background to the selection of adaptive building envelope elements is given in ISO/TR 52016-4.

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

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

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

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 9488, ISO 52000-1, ISO 52016-1, and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

**3.1 adaptive building envelope element**  
building envelope or part of it with at least one layer having physical properties that can be adapted in a reversible way as a (passive, intrinsic) response to transient conditions or actively controlled to adjust to transient conditions or changing priorities

Note 1 to entry: A part of a building envelope can be a product or assembly consisting of single or multiple layers, usually with transparent components.

EXAMPLE 1 Examples of an adaptive building envelope element:

- a window or facade with *dynamic solar shading* (3.7) (blind or shutter);
- a window with *chromogenic glazing* (3.6);
- a window or façade with an *actively ventilated cavity* (3.8).

EXAMPLE 2 Examples of conditions:

- external, such as climate;
- internal, such as occupants' requirements;
- local, such as material temperature.

EXAMPLE 3 Example of physical properties:

- thermal;
- optical;
- structural.

EXAMPLE 4 Example of changing priorities:

- minimizing the building energy use;
- optimizing indoor environment conditions;
- minimizing glare;
- maximizing privacy.