TECHNICAL REPORT

ISO/TR 52018-2

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Energy performance of buildings — Indicators for partial EPB requirements related to thermal energy balance and fabric features —

Part 2: Explanation and justification of ISO 52018-1

Performance énergétique des bâtiments — Indicateurs pour des exigences PEB partielles liées aux caractéristiques du bilan énergétique thermique et du bâti —

Partie 2: Explication et justification de l'ISO 52018-1

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www. iso. org/patents).

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

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

ISO/TR 52018-2 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 parts in the ISO 52018 series can be found on the ISO website.

Introduction

Relation between this document and the accompanying International Standard

For proper understanding of the present document, it is necessary to read it in close conjunction, clause by clause, with ISO 52018-1. Essential information provided in Part 1 is not repeated in this part. References to a clause refer to the combined content of that clause in both parts 1 and 2. Brief articles on the subject can be found in [20], [21] and [22].

The set of EPB standards, technical reports and supporting tools

In order to facilitate the necessary overall consistency and coherence, in terminology, approach, input/output relations and formats, for the whole set of EPB-standards, the following documents and tools are available:

a) a document with basic principles to be followed in drafting EPB-standards: CEN/TS 16628:2014, *Energy Performance of Buildings - Basic Principles for the set of EPB standards*[1];

b) a document with detailed technical rules to be followed in drafting EPB-standards: CEN/TS 16629:2014, *Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards*[2];

The detailed technical rules are the basis for the following tools:

1) a common template for each EPB standard, including specific drafting instructions for the relevant clauses;

2) a common template for each technical report that accompanies an EPB standard or a cluster of EPB standards, including specific drafting instructions for the relevant clauses;

3) a common template for the spreadsheet that accompanies each EPB (calculation) standard, to demonstrate the correctness of the EPB calculation procedures.

Each EPB standard follows the basic principles and the detailed technical rules and relates to the overarching EPB standard, ISO 52000-1 [3].

One of the main purposes of the revision of the EPB standards has been to enable that laws and regulations directly refer to the EPB standards and make compliance with them compulsory. This requires that the set of EPB standards consists of a systematic, clear, comprehensive and unambiguous set of energy performance procedures. The number of options provided is kept as low as possible, taking into account national and regional differences in climate, culture and building tradition, policy and legal frameworks (subsidiarity principle). For each option, an informative default option is provided (Annex B).

Rationale behind the EPB technical reports

There is a risk that the purpose and limitations of the EPB standards will be misunderstood, unless the background and context to their contents – and the thinking behind them – is explained in some detail to readers of the standards. Consequently, various types of informative contents are recorded and made available for users to properly understand, apply and nationally or regionally implement the EPB standards.

If this explanation would have been attempted in the standards themselves, the result is likely to be confusing and cumbersome, especially if the standards are implemented or referenced in national or regional building codes.

Therefore each EPB standard is accompanied by an informative technical report, like this one, where all informative content is collected, to ensure a clear separation between normative and informative contents (see CEN/TS 16629[2]):

— to avoid flooding and confusing the actual normative part with informative content,

— to reduce the page count of the actual standard, and

— to facilitate understanding of the set of EPB standards.

This was also one of the main recommendations from the European CENSE project[17] that laid the foundation for the preparation of the set of EPB standards.

This document

This document accompanies ISO 52018-1, which forms part of the set EPB standards.

The role and the positioning of the accompanied standard in the set of EPB standards is defined in the Introduction to ISO 52018-1.

General aspects of EPB indicators, requirements, ratings and certificates and application to the overall energy performance of buildings can be found in ISO 52003-1 [5] and ISO/TR 52003-2 [6].

Accompanying spreadsheet

Because in the accompanying document ISO 52018-1 no calculation procedures are defined, an accompanying calculation spreadsheet is not relevant.

Energy performance of buildings — Indicators for partial EPB requirements related to thermal energy balance and fabric features —

Part 2: Explanation and justification of ISO 52018-1

1 Scope

This document refers to ISO 52018-1.

ISO 52018-1 gives a succinct enumeration of possible requirements related to thermal energy balance features and to fabric features. It also provides tables for regulators to report their choices in a uniform manner. This document provides many background considerations that can help both private actors and public authorities, and all stakeholders involved, to take informed decisions.

This document does not contain any normative provision.

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 52018-1, *Energy performance of buildings – Indicators for partial EPB requirements related to thermal energy balance and fabric features – Part 1: Overview of options*

NOTE More information on the use of EPB module numbers, in all EPB standards, for normative references to other EPB standards is given in ISO/TR 52000-2.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 52018-1 apply.

More information on some key EPB terms and definitions is given in ISO/TR 52000-2[4].

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

4 Symbols and subscripts

For the purposes of this document, the symbols and subscripts given in ISO 52018-1 apply.

More information on key EPB symbols and subscripts is given in ISO/TR 52000-2[4].

5 General aspects

This document is fully complementary to ISO 52018-1. For a good comprehension, before reading a clause in this document, the corresponding (succinct) clause in ISO 52018-1 should be read, as this document does not repeat the content of ISO 52018-1, but only provides additional information.

This document contains many straightforward considerations with which many readers may already be familiar. In order for the text to also provide full support to novices in the field, such basic considerations have nevertheless been included. On the other hand, commonly circulating argumentations that could not withstand the test of critical, rational analysis have been omitted. It is self-evident, by the very nature of the topic, that the treatment can never be fully exhaustive; many additional motivations, for instance influenced by specific local conditions, may influence the final choice of the mix of energy features and indicators for which requirements are set.

For each of the partial EPB features enumerated in ISO 52018-1, this document formulates background considerations with respect to the following aspects (in as far as applicable):

— possible motivations,

— possible indicators,

— comparable economic strictness of the requirements,

— practical points of attention,

— testing,

— new construction and renovation issues,

— exceptions,

— other.

Achieving a good indoor environmental quality is one of the major objectives when designing buildings (first and foremost for the people in the building, but also for the proper preservation of any –specific– goods in the building). The topic of indoor environment is thematically and technically closely related to the energy efficiency of buildings, and both aspects are therefore logically considered in an integrated manner when building regulations are established. All the partial EPB features discussed in ISO 52018-1 and in this document are listed in Table 1 together with an indication whether indoor environment and/or energy efficiency is (are) usually the main motivation(s). (There may of course still be other possible reasons for setting a requirement, such as fabric preservation, but such other reasons are not visualized in the summary table.) Requirements on most EPB features may to a greater or lesser extent serve both purposes. The nuances are further discussed in each of the clauses.

Table 1 — Overview of the different partial EPB features

Clause	Partial EPB feature	Indoor environment	Energy efficiency
6	summer thermal comfort	X	(X)
7	winter thermal comfort	X	(X)
8	energy “need” for heating, or variants	(X)	X
9	energy “need” for cooling, or variants	(X)	X
10	combination of “needs”		X
11	overall thermal insulation of the envelope		X
12	thermal insulation of individual envelope elements	X	X
13	thermal bridges	X	X

Table 1 *(continued)*

Clause	Partial EPB feature	Indoor environment	Energy efficiency
14	window energy rating		X
15	airtightness	X	X
16	solar control	X	X

Often, an important consideration when setting EPB requirements is to achieve a strictness that is more or less cost optimal (at an assumed scenario of the future energy prices) for each individual construction project. This issue is explained in a general manner in ISO 52003-1[5] and ISO/TR 52003-2[6]. In this document, this aspect is discussed in a more practical manner for each of the EPB features.

6 Mix of EPB features with requirements

No additional information beyond ISO 52018-1.

7 Summer thermal comfort

7.1 Motivation

If there are complaints by the building users about the indoor environmental quality, it often includes summer thermal comfort. The occurrence of this problem can potentially be aggravated by EPB building regulations if these are not well-considered and well-equilibrated. Partial EPB requirements only dealing with the heating aspect may lead designer teams to maximize solar gains in winter, while neglecting the summer impact. And in uncooled buildings, or if active cooling would not be included in the overall energy performance assessment, even an overall EPB requirement can cause such single-sided design.

Setting a summer thermal comfort requirement may thus be an important complement in order to achieve a balanced, integral building design that performs well in all respects, both in winter and in summer. In addition, good summer indoor conditions strongly reduce the probability that active cooling will be installed later on during the lifetime of the building. In this manner such requirement thus also contributes in the long run to the energy saving goal.

7.2 Points of attention

Special consideration should be given to the potential issue that a diverging approach between uncooled and actively cooled buildings might result in unwanted consequences.

For instance, if overall EPB requirements and/or partial EPB requirements (e.g., on the cooling “need”) in actively cooled buildings are much more severe than in uncooled buildings, and if at the same time there is no attention in the building regulation for summer comfort in uncooled buildings, then the regulation might cause (especially in the segment of the construction market that is first cost dominated) an increase of uncooled building designs with uncomfortable summer conditions, resulting in the installation of (potentially less efficient) active cooling any time after construction.

Vice-versa, a requirement on summer thermal comfort in uncooled buildings that is not matched with (overall and/or partial) EPB requirements that equally impact cooled buildings, might possibly cause an undesired immediate shift in new construction towards actively cooled buildings for the sole reason of a regulatory requirement that is technically and/or economically more easily satisfied.

A possible approach to avoid such divergent regulatory treatment between uncooled and cooled buildings is to simply set for a given building category (such as dwellings, offices, schools, etc.) the same type of requirement and the same strictness for each building, independently of the fact whether or not the building is actively cooled. The requirement can either be a cooling “need” requirement (see Clause 10) for all buildings (so, also in buildings that are not actively cooled) or alternatively a summer thermal comfort requirement for all buildings (whereby in the evaluation of this requirement, it is assumed that the conditioning system in actively cooled building is switched off). It goes without saying that if certain design variables (e.g., operable windows) are treated differently in both features, the choice for one or the other of both features will or will not stimulate good use of these technical measures.

NOTE Sometimes, the fear is expressed that setting a cooling "need" requirement also for uncooled buildings might be perceived (or misconstrued) by some market actors as an implicit regulatory message that active cooling is the reference. However, experience has shown that clear (and permanent) public communication surrounding the regulation can avoid this issue. Moreover, the significant extra cost of effectively installing an active cooling system also constitutes a strong constraint, especially since spare capital is rarely available at the time of construction.

An alternative way of avoiding any unwanted consequences is to complement a summer thermal comfort requirement for all uncooled buildings (which is sufficiently strict to be meaningful) with a (technically and economically equally strict[1]) cooling need requirement (see Clause 10) for all actively cooled buildings.

Another possible source of divergent treatment between cooled and uncooled buildings may occur on the level of the overall EPB requirement. If the quantitative limit to the overall EPB indicator is identical for both types (i.e., actively cooled and uncooled) of buildings, it will not correspond to the cost optimal level of energy efficiency measures for each of both types. A carefully differentiated quantitative limit may solve this issue. Another approach is to have the same quantitative overall EP requirement, but to include for uncooled buildings a fictitious cooling consumption in the overall EP calculation, whereby the regulation sets a fixed overall cooling equipment efficiency and a fixed primary energy factor to convert the calculated cooling need to primary energy. Setting these values slightly more favourable than the best current technologies, avoids that cooled buildings would more easily satisfy the overall EP requirement, and thus be stimulated by the regulation (apart from all the other decision influencing factors, such as higher – first and operational – costs, controlled thermal environment, etc.). A disadvantage of fictitious cooling is that the relation between the calculated and real consumption diminishes (also in a principle manner, apart from all the different boundary conditions). In Annex D a further developed and more nuanced methodology is described that makes use of a conventional probability of a later installation of active cooling related to the risk of overheating.

A totally different point of attention concerns the zoning. The risk of overheating may vary strongly from 1 room to another, depending on very many factors, such as the solar gains (there is for instance often 2 times more glazing in a corner room than in a room of the same size in the middle of the sidewall of the building) and the internal gains (e.g., due to a strong difference in occupation density, for instance an individual office versus a cinema hall). Individual evaluation of all (types of) rooms in a building is usually not considered feasible within the context of a regulation[2], and (much) larger zones are typically used for any calculation. The resulting aggregation and intrinsic averaging will of course fail to reveal local summer comfort problems in specific rooms.

Vice-versa, another potential issue of zoning is related to the unavoidable simplifications of the modelling and the consequences this may have on the calculation of single rooms or small zones.

EXAMPLE For instance, a room (e.g., a bathroom) in the centre of a dwelling (e.g., an apartment) may have little or no transmission heat transfer towards the outside, and the transmission transfer towards adjacent rooms in neighbouring conditioned zones may by convention be considered nil in the EPB modelling. Also the ventilation heat transfer coefficient of this room by itself may be very small or even zero. A value of the internal gains that is considered representative for the average of the dwelling as a whole may actually be quite large for a bathroom, but is nevertheless often imposed by the fixed calculation conventions. When the summer thermal comfort of the bathroom is then evaluated, such combination of factors in the modelling may cause unrealistic results and it may even be that a summer requirement (i.e., the maximal value of the summer indicator) is mathematically impossible to satisfy.

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1) Or possibly stricter, if so desired.

2) Also, it would be difficult in a regulatory context to define differentiated internal gains for rooms with the same function, although this may in practice be one of the causes of local overheating.

When a summer thermal comfort requirement is imposed in the regulation, it may therefore be preferred to set it for sufficiently large zones. In residential buildings, it might be stipulated that the requirement always be evaluated for the entire dwelling or building unit (e.g., individual apartment) as whole, even if for other purposes smaller thermal zones are defined. But, for informative purposes only, it is of course still easily possible to evaluate (in a fully automated manner) the overheating indicator for each of the thermal zones apart, which have already been defined for other reasons. It is then up to the expertise of the programme user (assisted by the manual, help function, automated messages, etc.; and aided by his/her dedicated training and practical experience) to make a sound judgement whether a poor summer comfort indicator for a given zone reveals a true, physical problem, or whether it is caused by the intrinsic restrictions of the modelling (as in the bathroom example above).

7.3 Indicators

Several possible indicators can be considered for the summer thermal comfort.

For monthly calculations, the normalized non-useful gains for heating (which cause overtemperature above the heating set-point) have been shown to correlate well with the overheating above the thermal comfort limit.

For hourly calculations, a possible indicator is the number of hours (in h) on an annual basis that the free floating temperature exceeds a fixed reference temperature. Alternatively, the temperature weighted time (in Kh) above the fixed reference temperature can be used. The latter is a bit more sophisticated and increases more rapidly than the former (quadratic versus linear course). The latter thus better reveals the true extent of any summer discomfort problem and is therefore the preferred indicator. The fixed temperature that is chosen as reference will logically depend on the climate of the country or region.

NOTE 1 In buildings that satisfy a number of conditions (without active cooling, with operable windows, no strict dress code, etc.) a certain degree of user adaptation to high summer temperatures can occur. ISO 17772-1:2017, A.2[7] provides a model to evaluate the corresponding comfort level. For the buildings that fall within the application scope of the model, these calculations will of course give a much better indication of the summer comfort quality of the building, and are thus to be preferred for tailored design decisions. (But the important consideration with respect to the dependence of the result on the zoning (see 7.2) needs to be well kept in mind.)

NOTE 2 Because of its limited application range, the model in ISO 17772-1:2017, A.2 can however not be used to set a systematic regulatory requirement applicable to all buildings, e.g., to both actively cooled and uncooled buildings. For purely informative purposes, though, any EPB software could calculate (systematically and automatically or otherwise only upon request of the programme user) this indicator too. However, some extra user input might be needed if the aim is a calculation that is fully conform the adaptive comfort model. Apart from indicating the comfort class (I, II or III), the calculation could also provide a more continuous output, e.g., the temperature weighted time that the boundaries of class I are exceeded, so as to give finer feedback to designers on the impact of changing different variables.

7.4 Comparable economic strictness

For energy efficiency measures, a life cycle cost analysis allows to compare initial investments with all operational expenditures and thus to determine which set of technical measures is cost optimal. This can be the basis for setting requirements. For indoor environment aspects, such as summer thermal comfort, such economic analysis is in principle not applicable, as the benefits are difficultly quantifiable in monetary terms. A partial exception may be labour cost in offices and other workplaces: the loss of productivity due to thermal discomfort can be estimated (in a more or less rough manner) by means of (laboratory) experiments, or on the basis of experience, etc. This then in turn again allows a rudimentary economic optimization of summer comfort investments.

Alternatively, reasonable summer thermal comfort requirements may simply be taken as a starting point, and it can then be evaluated whether these are affordable in terms of investments. In many buildings (notably if the internal gains are not too high) judicious choice of window area, glazing type and orientation are an easy and relatively cheap means to limit overheating.

