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Energijske lastnosti stavb - Metoda za izračun energijskih zahtev in učinkovitosti sistema - 6-2. del: Razlaga in utemeljitev EN 15316-2 - Modula M3-5 in M4-5

Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-2: Explanation and justification of EN 15316-2, Module M3-5, M4-5

Energetische Bewertung von Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 6-2: Begleitende TR zur EN 15316-2 (Raumluftsysteme (Heizen und Kühlen))

Performance énergétique des bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 6-2 : Explication et justification de l'EN 15316-2, Module M3-5, M4-5

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European foreword

This document (CEN/TR 15316-6-2:2017) has been prepared by Technical Committee CEN/TC 228 “Heating systems and water based cooling systems in buildings”, the secretariat of which is held by DIN.

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

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.

Introduction

This standard is part of a set of standards developed to support EPBD directive implementation, hereafter called “EPB standards”.

EPB standards deal with energy performance calculation and other related aspects (like system sizing) to provide the building services considered in the EPBD directive.

CEN/TC 228 deals with heating systems in buildings. Subjects covered by CEN/TC 228 are:

a) energy performance calculation for heating systems;

b) inspection of heating systems;

c) design of heating systems;

d) installation and commissioning of heating systems.

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 [14];

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 [15];

c) 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 standard, to demonstrate the correctness of the EPB calculation procedures.

Each EPB-standards follows the basic principles and the detailed technical rules and relates to the overarching EPB-standard, EN ISO 52000-1 [16].

One of the main purposes of the revision of the EPB-standards is 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 [15]):

— 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 [18] that laid the foundation for the preparation of the set of EPB standards.

1 Scope

This Technical Report refers to standard EN 15316-2.

It contains information to support the correct understanding and use of EN 15316-2.

The scope of this specific part is to standardize the required inputs, the outputs and the links (structure) of the calculation method in order to achieve a common European calculation method.

This standard covers energy performance calculation of heating systems and water based cooling space emission sub-systems.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 215, *Thermostatic radiator valves - Requirements and test methods*

EN 416-2, *Single burner gas-fired overhead radiant tube heaters for non-domestic use - Part 2: Rational use of energy*

EN 419-2, *Non-domestic gas-fired overhead luminous radiant heaters - Part 2: Rational use of energy*

EN 442 (all parts), *Radiators and convectors – Part 2: Test methods and rating*

EN 1264 (all parts), *Water based surface embedded heating and cooling systems*

EN 14037 (all parts), *Free hanging heating and cooling surfaces for water with a temperature below 120°C*

EN 14337, *Heating Systems in buildings - Design and installation of direct electrical room heating systems*

EN 15316-1, *Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 1: General and Energy performance expression, Module M3-1, M3-4, M3-9, M8-1, M8-4*

EN 15316–2, *Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 2: Space emission systems (heating and cooling), Module M3-5, M4-5*

EN 15500, *Control for heating, ventilating and air-conditioning applications - Electronic individual zone control equipment*

EN 16430 (all parts), *Fan assisted radiators, convectors and trench convectors - Part 1: Technical specifications and requirements*

EN 60240–1, *Characteristics of electric infra-red emitters for industrial heating - Part 1: Short wave infra-red emitters (IEC 60240-1)*

EN ISO 7345:1995, *Thermal insulation - Physical quantities and definitions (ISO 7345:1987)*

EN ISO 13790, *Energy performance of buildings - Calculation of energy use for space heating and cooling (ISO 13790)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, EN ISO 52000-1:2017, and the following apply.

3.1
heat losses
emissions within the heating system as losses through the building envelope due to non-uniform temperature distribution, control inefficiencies and losses of emitters embedded in the building structure

3.2
cooling losses
emissions within the cooling system as losses through the building envelope due to non-uniform temperature distribution, control inefficiencies and losses of emitters embedded in the building structure

3.3
total heat losses
sum of the heat losses within the heating system from the system, including recoverable heat loss

3.4
total cooling losses
sum of the cooling losses within the cooling system from the system, including recoverable cooling loss

3.5
control
self-acting device with and without auxiliary energy to keep a physical condition as temperature, humidity, etc. close to set-point

3.6
room automatisation controls
BMS
room temperature controls in combination with:

— timer function;

— timer function and self-adoption / self-optimization;

timer function and self-adoption / self-optimization and interaction with other components of heating / cooling system like further controls, circulator or heat- / cool-generator (net work operation)

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the following symbols (see Table 1) apply:

Table 1 — Symbols and units

Symbol	Quantity	Unit
RF	Radiant factor	-

4.2 Subscripts

For the purposes of this document, the following subscripts (see Table 2) apply:

Table 2 — Subscripts

emb	embedded	*im*	*intermittent*	*pmp*	*pump*
fan	*fan*	*ini*	initial	*rad*	*radiant*
emt	*emitter*	*inc*	increased	*str*	stratification
hydr	*hydraulic balancing*	*roomaut*	room automation	Δ	additional
out	*output*	*sol*	*solar*		

5 Description of the method

5.1 Output of the method

The method described in this standard calculate

— energy losses (heating and cooling) $Q_{em,ls}$ in kWh;

— auxiliary energy – heat/ cooling emission W_{em} in kWh;

— room temperature $\theta_{\mathrm{int},inc}$ in Centigrade (°C).

The time step of the output can be:

— hourly;

— monthly;

— yearly;

according to the time-step of the input.

5.2 General description of the method

5.2.1 General

The energy performance is assessed by values of the increased space temperatures due to heat and cooling emission system inefficiencies.

The method is based on an analysis of the following characteristics of a space heating emission system or cooling system including control:

— non-uniform space temperature distribution;

— emitters;

— emitters embedded in the building structure;

— control accuracy of the indoor temperature;

— operation of controls / controls systems and emitters.

The energy required by the emission system is calculated separately for thermal energy and electrical energy in order to determine the final energy, and subsequently the corresponding primary energy is calculated.

The calculation factors for conversion of energy requirements to primary energy shall be decided on a national level.

5.2.2 non-uniform space temperature distribution

The additional energy loss, based on non- uniform space temperature distribution can be caused by:

— a temperature stratification, resulting in an increased internal temperature under the ceiling and upper parts of the room;

— an increased internal temperature and heat transfer coefficient near windows;

— convection and radiation from the heating system through other outside surfaces.

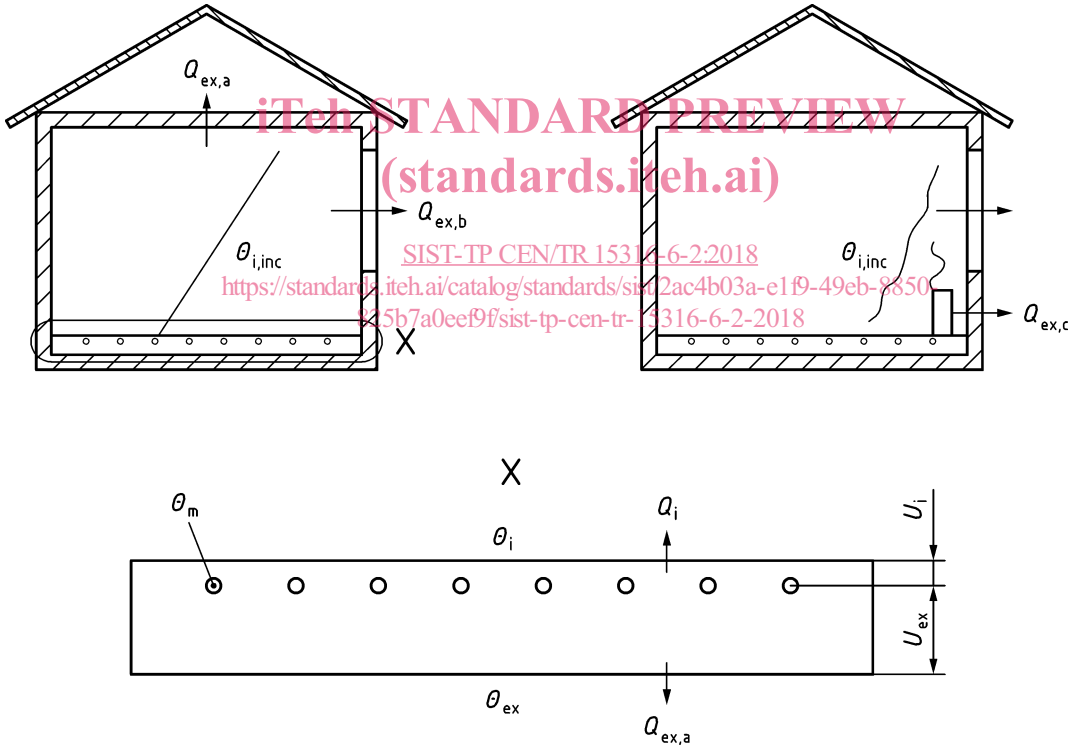

Figure 1 — Effects due to non-uniform temperature distribution and position of heat and cooling emitter

Figure 1 shows some examples for the non-uniform temperature distribution.

5.2.3 Heat loss of embedded surface heating devices due to additional transmission to the outside

This applies to floor heating, ceiling heating and wall heating systems and similar.

This is only considered as a loss when one side of the building part containing the embedded heating device is facing the outside, the ground, an unheated space or a space belonging to another building unit.

If embedded heat emitters with different characteristics (e.g. insulation) are used in the heating installation, it is necessary to take this into account by separate calculations.

If the increased temperature in the building element has been taken into account in the calculations according to EN ISO 13790, this shall not be done again.

5.2.4 Control of the indoor temperature

This method covers only control of the heat emission system and does not take into account the influences, which the control (central or local) may have on efficiency of the heat generation system and on heat losses from the heat distribution system.

A non-ideal control may cause temperature variations and drifts around the prefixed set point temperature, due to the physical characteristics of the control system, sensor locations and characteristics of the heating system itself. This may result in increased or decreased heat losses through the building envelope compared to heat losses calculated with the assumption of constant internal temperature. The ability to utilize internal gains (from people, equipment, solar radiation) depends on the type of heat emission system and control method (Figure 2). The calculation of the energy use according to EN ISO 13790 are based on a constant internal temperature, while the real room temperature (as indicated in Figure 2) will vary according to control concept and variations in internal loads.

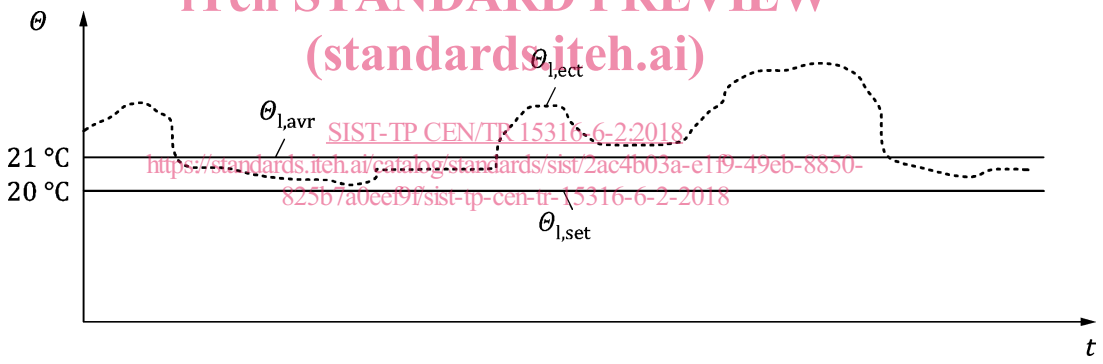

Figure 2 — Effect of control accuracy as efficiency or equivalent increase in space temperature

5.2.5 Effects of room automatisation

Heating or cooling systems in residential and non-residential buildings can demand-oriented operated intermittently. The reduction in room temperature with intermittent operation of heating systems depends essentially on the reduction- or off time, the transmission and ventilation heat loss, the outside temperature as well as the effectual thermal mass of the room. With room automatisation systems the potential reduction of room temperature can be utilized better. Because the above mentioned influencing factors are often unknown a global temperature variation caused by room automatisation is assumed. Regarding the functionality of the room automatisation system it is differentiated into 3 levels as follows with increasing temperature variation.

1. stand alone room automatisation

This covers systems without networked operation and fixed heating-up times.

2. stand alone room automatisation with self-adoption start / stop

This covers systems without networked operation and optimized heating-up times.

3. networked room automatisation with self-adoption and interaction

This covers systems with networked operation and optimized heating-up times.

5.2.6 Combined outside temperature for cool emission systems

In addition to the difference between room and outside temperature the cooling load is influenced essentially by solar and internal gains. To account for this, the outside temperature is corrected by a temperature difference to ensure adequate temperature differences between room and outside temperature as reference value for the calculation of additional emission losses.

6 Calculation Method

6.1 Output data

The output data of this method are listed in Table 3.

Table 3 — Output data of this method

Description	Symbol	Unit	Validity interval	Intended	Varying
auxiliary energy – heating / cooling emission	$W_{em,ls,aux}$	kWh	0…∞	M3–1	YES
additional energy losses of heat emission	$Q_{em,ls}$	kWh	0…∞	M3–1	YES
equivalent internal heating temperature	$\theta_{H;int;inc}$	°C	−5 … 40	M3–1	YES
equivalent internal cooling temperature	$\theta_{C;int;inc}$	°C	−5 … 40	M4–1	YES
temperature variation based on losses	$\Delta\theta_{int;inc}$	°C	−5 … 40	M3–1	YES
annual expenditure factor for the heat and cooling emission	$\varepsilon_{em,ls,an}$	-	1…2	M3–1	NO
convective fraction of the heating/cooling emitter	$f_{em,conv}$	-	0..1	M3–1 / M2–2	NO

6.2 Calculation time steps

The objective of the calculation is to determine the annual energy demand or the energy demand of a time period of the space heating / cooling emission system. This may be done in one of the following two different ways:

— by using annual data for the system operation period and perform the calculations using annual average values;

— by dividing the year into a number of calculation periods (e.g. year, month, week, day, hour, boosted sub-period) and perform the calculations for each period using period dependent values and adding up the results for all the periods over the year.

6.3 Input data

6.3.1 Source of data

Input data about products that are required for the calculation described in this standard shall be the data supplied by the manufacturer if they are declared according to relevant EN product standards.

If no such data from the manufacturer is available or if the required data are not product data, default values are given in Annex B.

6.3.2 Product data (technical data)

The product data shall be the value declared by the manufacturer according to certified measurements performed according to the relevant product standards. If values declared by the manufacturer are not available, then default values are given in informative Annex B.

Required technical data for this calculation procedure are listed in Table 4.