SLOVENSKI STANDARD
SIST-TP CEN/TR 15316-6-4:2018

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Energijske lastnosti stavb - Metoda za izračun energijskih zahtev in učinkovitosti sistema - 6-4. del: Razlaga in utemeljitev EN 15316-4-1 - Modula M3-8-1 in M8-8-1

Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-4: Explanation and justification of EN 15316-4-1, Module M3-8-1, M8-8-1

Heizungsanlagen und Wasserbasierte Kühlanlagen in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 6-4: Begleitender TR zur EN 15316-4-1 (Wärmeerzeugung für die Raumheizung und Trinkwarmwasser, Verbrennungssysteme (Heizungskessel, Biomasse))

Performance énergétique des bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 6-4 : Explication et justification de l'EN 15316-4 -1, Module M3-8-1, M8-8-1

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Heizungsanlagen und Wasserbasierte Kühlanlagen in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 6-4: Begleitender TR zur EN 15316-4-1 (Wärmeerzeugung für die Raumheizung und Trinkwarmwasser, Verbrennungssysteme (Heizungskessel, Biomasse))

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Contents

Page

European foreword

This document (CEN/TR 15316-6-4:2017) 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.

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Introduction

This document informs about EN 15316-4-1 as a part of a series of standards aimed at European harmonization of the methodology for the calculation of the energy performance of buildings.

A huge amount of informative contents needs indeed to be recorded and made available for users to properly understand, apply and nationally adapt the EPB standards.

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];

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 [3].

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

EN 15316-4-1 is intended to replace EN 15316-4-1:2008 and includes Domestic hot water systems, generation (former EN 15316-3-3) and biomass boilers (former EN 15316-4-7:2008) in this standard published in 2007-2008 under the mandate M/343 on the EPBD. This revision was required as a result of the EPBD recast (2010/31/EU).The set of standards developed under mandate M/343 will be revised to become consistent with the overarching standard under mandate M/480.

The typology method has been removed, the boiler cycling method has been added for existing boilers to get the input parameters for the case specific boiler efficiency method.

Other generation systems are covered in other sub modules of part M3-8 (see Figure 1).

1 Scope

This Technical Report refers to EN 15316-4-1.

It contains information to support the correct understanding, use and national adaption of standard EN 15316-4-1.

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 89, *Gas-fired storage water heaters for the production of domestic hot water*

EN 13203-2, *Gas-fired domestic appliances producing hot water - Part 2: Assessment of energy consumption*

EN 15316-4-1:2017, *Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating and DHW generation systems, combustion systems (boilers, biomass), Module M3-8-1, M8-8-1*

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, symbols, abbreviations and indices

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 52000-1:2017 and EN 15316-4-1:2017 apply.

3.2 Symbols

For the purposes of this document, the symbols and indices given in EN ISO 52000-1:2017 and the symbols and units given in EN 15316-4-1:2017 apply.

3.3 Abbreviations and indices

For the purposes of this document, the abbreviations and indices given in EN ISO 52000-1:2017 and the indices given in EN 15316-4-1:2017 apply.

4 Description of the method

4.1 Output of the method

4.1.1 Description

The calculation of the values takes place basically for the zones defined in EN ISO 13790.

If a number of parts of systems are contained in the various process domains then the values are to be added together for further analysis.

Here it is to be taken into account that the heating data are to be related to the gross calorific value.

In the following sections the thermal and auxiliary energy components of the different process domains are determined for further analysis in ISO/CD 11368.

For output quantities, see Table 1.

Table 1 — Output quantities

Description	Symbol	Unit	Calculation clause of EN 15316-4-1:2017	Validity interval	Destination module	Varying
Fuel heat input	$E_{gen;in}$	kWh	see 6.3	0…∞	M 3–1	YES
Recoverable generation heat losses for heating system (in the calculation interval)	$Q_{gen;ls;rbl}$	kWh	see 6.6	0…∞	M 3–1	YES
generation heat losses (in the calculation interval)	$Q_{gen;ls;}$	kWh	see 6.5	0…∞	M 3–1	YES
Expenditure factor of the generator for the whole service	ε_{gen}	-	see 6.2	1 - 10	M 3–1	YES
Expenditure factor of the generator for heating	$\varepsilon_{H;gen}$	-	see 6.2	2 - 10	M 3–1	YES
Expenditure factor of the generator for cooling	$\varepsilon_{C;gen}$	-	see 6.2	3 - 10	M 3–1	YES
Expenditure factor of the generator for ventilation	$\varepsilon_{V;gen}$	-	see 6.2	4 - 10	M 3–1	YES
Expenditure factor of the generator for DHW	$\varepsilon_{W;gen}$	-	see 6.2	5 - 10	M 3–1	YES
heat generation auxiliary energy for the heating system (in the calculation interval)	$W_{gen,}$	kWh	see 6.4	0…∞	M 3–1	YES
Fuel type		List		not relevant	M 3–1	NO

4.1.2 Example

Table 2 — Example for output quantities

Description	Symbol	Value
Fuel heat requirement	$E_{gen;in}$	99 443 kWh = 357,995 GJ
Recoverable heat loss	$Q_{gen;ls;rbl}$	408 kWh = 1,468 GJ
Total generation heat loss	$Q_{gen;ls}$	1 574 kWh = 5,667 GJ
Auxiliary consumption	W_{gen}	524,34 kWh = 1,888 GJ
expenditure factor of the generator		
for the whole service	ε_{gen}	0,99
for heating	$\varepsilon_{H;gen}$	0,99
for cooling	$\varepsilon_{C;gen}$	0,00
for ventilation	$\varepsilon_{V;gen}$	0,00
for DHW	$\varepsilon_{W;gen}$	0,00

4.2 General description of the method

The calculation method of the generation sub-system takes into account heat losses and/or recovery due to the following physical factors:

— heat losses to the chimney (or flue gas exhaust) and the generator(s) during total time of generator operation (running and stand-by);

— auxiliary energy.

The calculation is independent from the time steps.

There are a basic calculation for

— boilers at all (EN 15316-4-1:2017, Clause 6.);

— direct heated domestic hot water heaters (EN 15316-4-1:2017, 6.11) and

— domestic hot water appliance tested with 24 h tapping cycles (EN 15316-4-1:2017, 6.12).

There are three possible inputs for the generation efficiency calculation:

— default values (EN 15316-4-1:2017, 5.5);

— product values (EN 15316-4-1:2017, 5.6);

— measured values (EN 15316-4-1:2017, 5.7).

Default values are given in Annex B.

Product values by the manufactures should be tested according to the appropriated European Standard (see Bibliography).

Measured values are for existing boilers, condensing boilers and on-site inspection (see 5.6).

Here it is to be taken into account that the heating data are to be related to the gross calorific value.

4.3 Input data

4.3.1 Description

Input quantities from other parts of the heating system standards, see Table 3.

Table 3 — Input quantities

Description	Symbol	Unit	Validity interval	Destination module	Varying
Fuel type	GEN_FUEL	List	not relevant	M 3–4, M 8–4	NO
Generator Type	GEN_TYP	List	not relevant	M 3–4, M 8–4	NO
Burner type	GEN_BURN	List	not relevant	M 3–4, M 8–4	NO
Boiler location	TH_ZONE	List	not relevant	M 3–4, M 8–4	NO
Type of control	HEAT_GEN_CTRL	List	not relevant	M 3–4, M 8–4	NO
Generation circuit typology	GEN_CIRC_TYPOL	List	not relevant	M 3–4, M 8–4	NO
number of dwellings within a building	N_{flat}	-	0…∞	M 3–1	YES
number of peak tappings per day	n_{Sp}	-	0…∞	M 3–1	YES
Heat load	Φ_h	kW	0…∞	M 3–3	YES
Rated output for cooling system	$P_{n,C}$	kW	0…∞	M 4–3	YES
Rated output for ventilation system	$P_{n,V}$	kW	0…∞	M 5–3	YES
Rated output for DHW system	$P_{n,W}$	kW	0…∞	M 8–3	YES
Heat input to the heating distribution system (in the respective time)	$Q_{H,dis;in}$	kWh	0…∞	M 3–6,	Yes
Heat input to the cooling distribution system (in the respective time)	$Q_{C,dis;in}$	kWh	0…∞	M 4–6	YES
Heat input to the ventilation distribution system (in the respective time)	$Q_{V,dis;in}$	kWh	0…∞	M 5–6,	YES
daily energy need for domestic hot water,	$Q_{W,b,d}$	kWh	0…∞	M 8–6	YES
Heat input to the domestic hot water distribution system (in the respective time)	$Q_{W,dis;in}$	kWh	0…∞	M 8–6	YES
Usage period for heating (in the calculation interval),	$t_{H;use}$	h or d	0…8760	M 3–4, M 8–4	YES
Usage period for cooling (in the calculation interval)	$t_{C;use}$	h or d	0…8760	M 4–4	YES
Usage period for ventilation (in the calculation interval)	$t_{V;use}$	h or d	0…8760	M 5–4	YES
Usage period for domestic hot water (in the calculation interval)	$t_{W;use}$	h or d	0…8760	M 8–4	YES
Running time for heating (in the calculation interval)	t_H	s/h or h/mth	0…3600	M 3–4, M 8–4, EN ISO 13790	YES
Running time for cooling system – when connected	t_C	s/h or h/mth	0…3600	M 3–4, M 8–4	YES
Running time for ventilation system – when connected	t_V	s/h or h/mth	0…3600	M 3–4, M 8–4	YES
Running time for DHW system – when connected	t_W	s/h or h/mth	0…3600	M 3–4, M 8–4	YES

Description	Symbol	Unit	Validity interval	Destination module	Varying
External air temperature	ϑ_{e}	°C	−30 . . +30	see external climate data, M 3–4, M 8–4	YES
Daily average design temperature	$\vartheta_{e;min}$	°C	−30 . . +31	see external climate data, M 3–4, M 8–5	YES
Generator average water temperature (or return temperature to the generator for condensing boilers) as a function of the specific operating conditions	$\vartheta_{Hc;mn}$	°C	0 . . 110	M 3–4, M 8–4	YES
Average return temperature to the generator for condensing boilers as a function of the specific operating conditions	$\vartheta_{Hc;RT}$	°C	0 . . 110	M 3–4, M 8–4	YES
Generator average water temperature as a function of the specific operating conditions for cooling systems - when connected	$\vartheta_{Cc;mn}$	°C	0 . . 110	M 3–4, M 8–4	YES
Generator average water temperature as a function of the specific operating conditions for ventilation systems - when connected	$\vartheta_{Vc;mn}$	°C	0 . . 110	M 3–4, M 8–4	YES
Generator average water temperature as a function of the specific operating conditions for DHW systems - when connected	$\vartheta_{Wc;mn}$	°C	0 . . 110	M 3–4, M 8–4	YES
Average return temperature to the generator for condensing boilers as a function of the specific operating conditions for cooling systems - when connected	$\vartheta_{Cc;RT}$	°C	0 . . 110	M 3–4, M 8–4	YES
Average return temperature to the generator for condensing boilers as a function of the specific operating conditions for ventilation systems - when connected	$\vartheta_{Vc;RT}$	°C	0 . . 110	M 3–4, M 8–4	YES
Average return temperature to the generator for condensing boilers as a function of the specific operating conditions for DHW systems - when connected	$\vartheta_{Wc;RT}$	°C	0 . . 110	M 3–4, M 8–4	YES
Average return temperature to the generator for condensing boilers	$\vartheta gen;RT$	°C	−30 . . +30	measured	YES
Ambient temperature	ϑ_{brm}	°C	−30 . . +31	M 3–4, M 8–4	YES
Cold water temperature	ϑk	°C	0 . . 95	M 3–4	YES
Delivered energy input of the generation sub-system (measured fuel input) (in the calculation interval)	$Egen;del;in$	kg, m^3	0…∞	M 3–1	YES

Description	Symbol	Unit	Validity interval	Destination module	Varying
Generator output at full load	*P*n	kW	0…∞	M 3–2	YES
Generator output at intermidiate load	*P*int	kW	0…∞	M 3–3	YES
Temperature difference between boiler return water temperature and flue gas temperature at part load	*Δϑ*wfg	°C	−30 . . +30	measured	YES
External air temperature	*ϑ*e	°C	−30 . . +30	see external climate data, M 3–4, M 8–4	YES
Ambient temperature	*ϑ*brm	°C	−30 . . +31	see external climate data, M 3–4, M 8–5	YES
Out of additional tests					
Full load efficiency with mean water temperature ϑgen;test;Pn;add	*ηPn;add*	-	0 . . 1	measured	YES
Mean water temperature at full load	*ϑgen;test;Pn;add*	°C	−30 . . +30	measured	YES
Part load efficiency with mean water temperature ϑgen;test;Pint;add	*ηPint;add*	-	0 . . 1	measured	YES
Mean water temperature at part load	*ϑgen;test;Pint;add*	°C	−30 . . +31	measured	YES

The daily operation is taken into account by the heating time (operating hours/period of duration) $t_{H,op}$. The assumption is made that there is always only one user. Where there are a number of different loads a differentiation shall be made between the individual requirements for each case.

Only if the useful heat demand *Q*H;dis;in > 1 kWh (in the calculation interval) is heating necessary.

If the generator provides heat for heating, cooling, ventilation and domestic hot water, the index H shall be replaced by C, V or W. In the following only H is used for simplicity.

4.3.2 Example

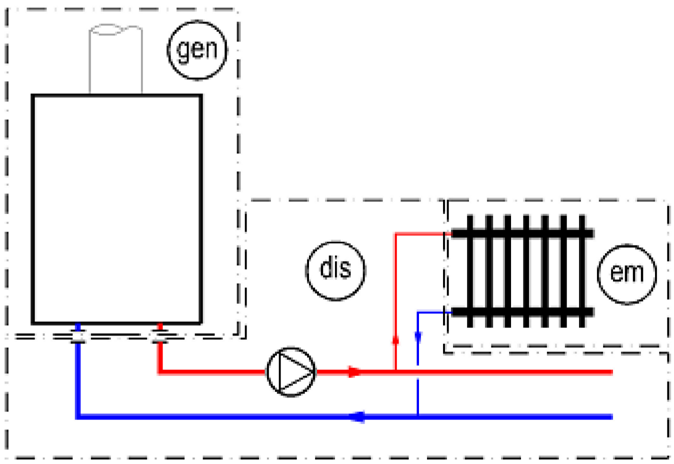
Table 4 — Example of input quantities

Description	Symbol	Value
Boiler type		Gas Condensing boiler 2005
Nominal power (heat output)	P_n	70 kW
Fuel used.		Natural gas
Burner type		Modulating, fan assisted
Boiler location		Boiler room
Type of control		Depending on outside temperature
Generation circuit typology		Direct connection of boiler
Generator heat output	$Q_{H;gen;out}$	353 GJ = 98 000 kWh
Usage period for heating	$t_{H,use}$	160 d = 3 840 h
Generation average temperature	$\vartheta_{Hc;mn}$	48,9 °C
Generation return temperature	$\vartheta_{Hc;RT}$	37,7 °C
load factor at full load	β_{Pn}	β_{Pn} = 1,0 (single boiler, only heating load)
load factor at intermediate load	β_{Pint}	β_{Pint} = 0,3 (single boiler, only heating load)

4.4 Boundaries between distribution and generation sub-system

Boundaries between generation sub-system and distribution sub-system should be defined according to the following principles.

If the generation-subsystem includes the generator only (i.e. there is no pump within the generator), the boundary with the distribution sub-system is represented by the hydraulic connection of the boiler, as shown in Figure 1.



Key

gen generation subsystem

dis distribution subsystem

em emission subsystem

Figure 1 — Sample subsystems boundaries