SLOVENSKI STANDARD
oSIST prEN 15316-5:2022

01-maj-2022

Energijske lastnosti stavb - Metoda za izračun energijskih zahtev in učinkovitosti sistema - 5. del: Sistemi za ogrevanje prostora in shranjevanje tople sanitarne vode (brez hlajenja) - Modula M3-7 in M8-7

Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7

Energetische Bewertung von Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen -Teil 5: Raumheizung und Speichersysteme für erwärmtes Trinkwasser (keine Kühlung), Module M3-7, M8-7

Performance énergétique des bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 5 : Systèmes de stockage pour le chauffage et l'eau chaude sanitaire (sans refroidissement), Module M3-7, M8-7

Ta slovenski standard je istoveten z: **prEN 15316-5**

ICS:

91.140.10	Sistemi centralnega ogrevanja	Central heating systems
91.140.65	Oprema za ogrevanje vode	Water heating equipment

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English Version

Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7

Performance énergétique des bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 5 : Systèmes de stockage pour le chauffage et l'eau chaude sanitaire (sans refroidissement), Module M3-7, M8-7

Energetische Bewertung von Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen -Teil 5: Raumheizung und Speichersysteme für erwärmtes Trinkwasser (keine Kühlung), Module M3-7, M8-7

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 228.

If this draft becomes a European Standard, 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.

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

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European foreword

This document (prEN 15316-5:2022) 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 will supersede EN 15316-5:2017.

The main changes compared to EN 15316-5:2017 are:

1) inclusion of simultaneous heating of the storage;

2) inclusion of arbitrary layer volume selection;

3) inclusion of additional heat losses due to the thermosyphon circulation;

4) calculation procedure for method A and B have been reviewed and several changes implemented;

5) Annex A contains a template for the data and parameters used in the standards and Annex B a set of default values. Default values given in Annex B may be overridden by a national annex;

6) the previous Annex C and Annex D have been withdrawn;

7) inclusion of matrix approach for solving the re-arranging of the layer temperatures in method A

Introduction

This document is part of a series of standards aiming at international harmonization of the methodology for the assessment of the energy performance of buildings, called “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.

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

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

— energy performance calculation for heating and cooling systems;

— inspection of heating systems;

— design of heating systems and water based cooling systems;

— installation and commissioning of heating systems.

This document specifies two methods to take into account the energy performance of storage systems for heating of domestic hot water coupled to generation system(s) producing hot water or using independent energy input to the storage unit. This document presents two methods applicable to the different technologies of water based storage system and related controls systems:

— method A applies when the hot water is thermally stratified;

— method B applies when the hot water contained in the storage unit(s) is thermally homogeneous.

For the correct use of this document, Annex A specifies the required choices and input data. Default choices and input data are presented in Annex B. In case the 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. These choices can be made available as National Annex or as separate (e.g. legal) document. If the default values and choices in Annex A are not followed due to national regulations, policy or traditions, it is expected that:

— either the national standardization body will consider the possibility to add or include a National Annex in agreement with the template of Annex A;

— or the national or regional authorities will, in the building regulations, reference the standard and prepare data sheets containing the national or regional choices and values, in agreement with the template of Annex A.

This updated document covers hourly calculation intervals (or shorter).

1 Scope

This document covers energy performance calculation of water based storage sub-systems used for heating, for domestic hot water or for combination of these.

This document does not cover sizing or inspection of such storage systems.

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 EN ISO 52000-1.

NOTE 1 In CEN ISO/TR 52000-2, 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 2 The modules represent EPB standards, although one EPB standard may cover more than one module and one module may 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, within the modular structure of the set of EPB standards

Overarching			Building (as such)		Technical Building Systems										
	Descriptions			Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation & control	Electricity production
sub 1		M1	sub 1	M2	sub 1		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General		1	General	1	General									
2	Common terms and definitions; symbols, units and subscripts		2	Building Energy Needs	2	Needs									
3	Applications		3	(Free) Indoor Conditions without Systems	3	Maximum Load and Power									
4	Ways to Express Energy Performance		4	Ways to Express Energy Performance	4	Ways to Express Energy Performance									
5	Building Functions and Building Boundaries		5	Heat Transfer by Transmission	5	Emission and control									
6	Building Occupancy and Operating Conditions		6	Heat Transfer by Infiltration and Ventilation	6	Distribution and control									
7	Aggregation of Energy Services and		7	Internal Heat Gains	7	Storage and control	15316-5					15316-5			

Overarching			Building (as such)		Technical Building Systems										
	Descriptions			Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation & control	Electricity production
sub 1		M1	sub 1	M2	sub 1		M3	M4	M5	M6	M7	M8	M9	M10	M11
	Energy Carriers														
8	Building Partitioning		8	Solar Heat Gains	8	Generation									
					8–1	Combustion boilers									
					8–2	Heat pumps									
					8–3	Thermal solar Photovoltaics									
					8–4	On-site cogeneration									
					8–5	District heating and cooling									
					8–6	Direct electrical heater									
					8–7	Wind turbines									
					8–8	Radiant heating, stoves									
9	Calculated Energy Performance		9	Building Dynamics (thermal mass)	9	Load dispatching and operating conditions									
10	Measured Energy Performance		10	Measured Energy Performance	10	Measured Energy Performance	15378-3					15378-3			
11	Inspection		11	Inspection	11	Inspection	15378-1					15378-1			
12	Ways to Express Indoor Comfort		12	–	12	BMS									
13	External Environment Conditions														
14	Economic Calculation	15459 -1													

NOTE The shaded modules are not applicable.

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.

EN ISO 7345:2018, *Thermal performance of buildings and building components — Physical quantities and definitions (ISO 7345:2018)*

EN ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures (ISO 52000-1:2017), Module M1-1, M1-9*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:2018 and EN ISO 52000-1:2017 and the following apply.

3.1
layer
part of the volume of the whole storage which is considered having homogeneous temperature

3.2
minimum temperature of domestic hot water
minimum temperature required to state that it is usable (same as draw off temperature if neglecting thermal losses along the pipe during draw off)

3.3
required storage output for domestic hot water
energy output from the storage to be delivered to the domestic hot water distribution system (without the circulation loop thermal losses)

3.4
required storage output for domestic hot water circulation system
energy output from the storage to cover domestic hot water circulation loop thermal losses

3.5
required storage output for space heating
energy output from the storage to be delivered to space heating distribution system

3.6
usable energy
accumulated energy in the storage/layer available at the temperature above or equal to the min. required value for domestic hot water or space heating service

3.7
energy input to the storage from the generation system
energy delivered to the storage by external/internal heater and/or solar loop

3.8
energy deficiency to be supplied by other systems
amount of energy that cannot be provided by heater(s) plus accumulated energy to cover the demand

3.9
thermosyphon circulation
natural circulation within connecting pipe due to temperature difference between storage and fluid in pipes when circulation pump is off

3.10
additional heat loss for connections (accounts thermosyphon circulation)
additional storage thermal loss that take into account the presence of thermosyphon circulation within connection pipes

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in EN ISO 52000-1 apply.

4.2 Subscripts

For the purposes of this document, the subscripts given in EN ISO 52000-1 and the specific subscripts listed in Table 2 apply.

Table 2 —Subscripts

Subscript	Term	Subscript	Term
bu	heater	ls	losses
stby	standby	amb	ambient
ref	reference	mn	mean
vol,i	layer index	RT	return temperature
cold	cold water	Hc	heating circuit
ubl	usable	sol	solar
nsup	supplied by other systems (if available)	exh	heat exchanger
use	used	sh	space heating
nd	needed	ch	consecutive hours
ncons	no consumption	avb	available

5 Description of the methods

5.1 Output of the method

This method covers the calculation of energy delivered to the storage systems, energy delivered from the storage systems to the domestic hot water and space heating distribution system and thermal losses (recoverable or not) of storage systems used for heating and/or domestic hot water.

This method is only suitable for hourly time step (or shorter).

5.2 Extension of the method

The method which is presented in the standard can be extended to storage systems with multiple storage units.

The adaptation depends on the hydraulic schema used for the design of the storage system:

— serial connection – the storage units are hydraulically linked as the output of the storage unit 'n' become the input of the storage unit 'n+1'. By default, hot water is delivered to the distribution system from output of the last storage unit in series and the control system sets the priority of energy input to the particular unit (e.g. based on the achieved storage units water content temperature in the previous time step);

— parallel connection – the control systems sets the priority (hot water/energy output/input) for the storage units that are considered independently.

5.3 Technologies covered and schematic of the hot water storage system

The following storage units and control systems are covered:

— type of heating source and withdraw connection: direct connection, heat exchanger;

— type of heat withdraw: domestic hot water or heating energy;

— position of heating source(s) and heat withdrawal(s) within the storage unit (heated layer, only in method A);

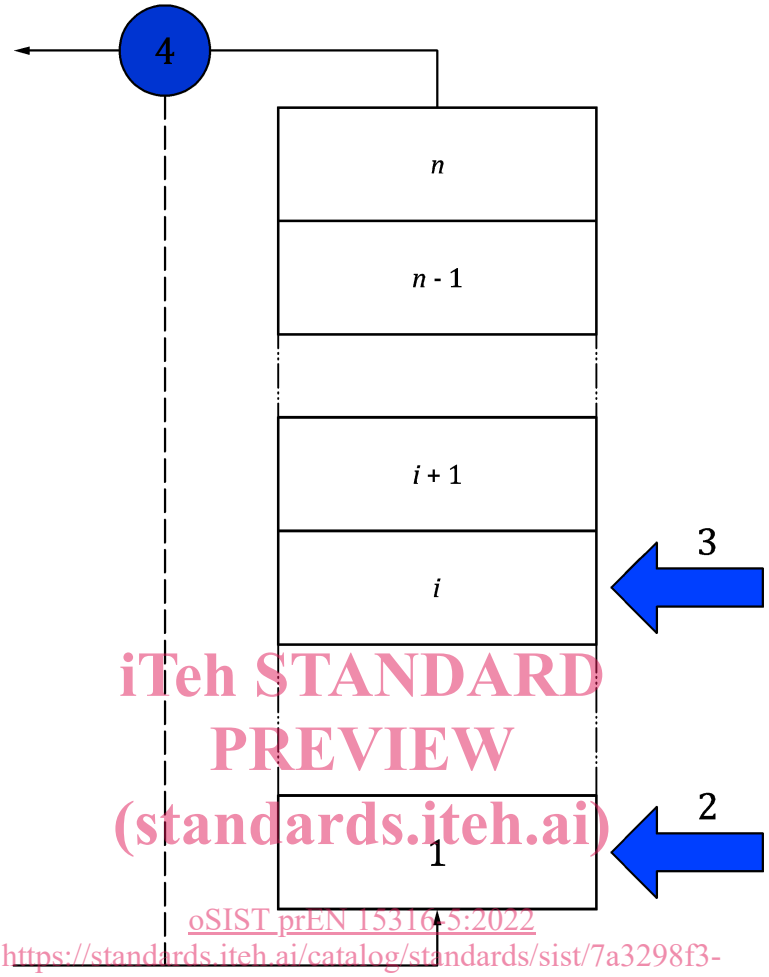
— control strategy of the storage temperature:

  — based on availability of energy delivered to the storage unit(s);

  — priority given to domestic hot water, then space heating (by default);

  — priority to solar heating, then additional heater(s).

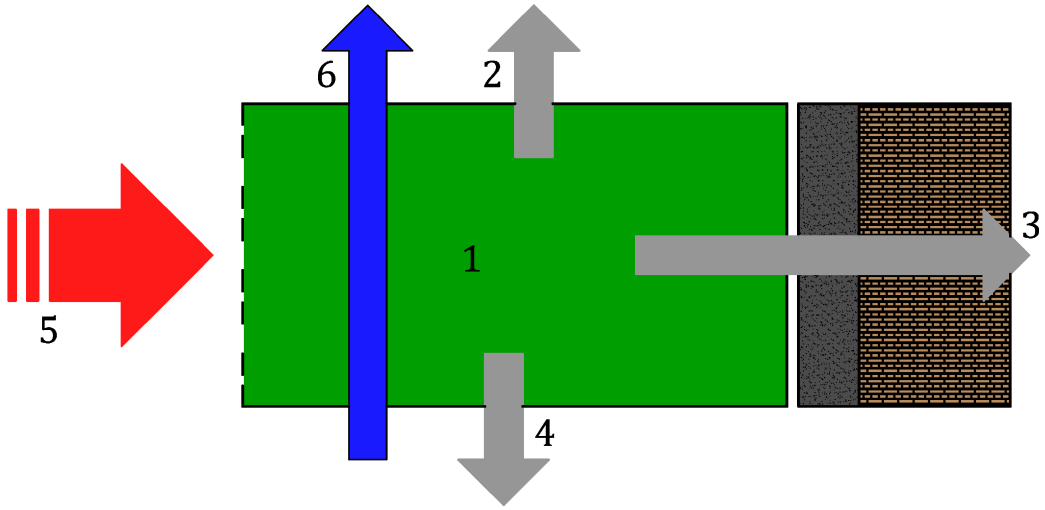
5.4 Principles of the calculation of hot water storage systems by layers



Key

1	layer 1	i+1	layer i+1
2	energy input	n-1	layer n-1
3	energy input	n	layer n – number of layers
i	layer i	4	mixing valve

Figure 1 — General model of the layered storage unit



Key

1 layer i
2 energy exchange due to thermal conduction with the upper layer
3 energy exchange with ambient – contribution of layer i to thermal losses
4 energy exchange due to thermal conduction with the lower layer i-1
5 energy input into volume i
6 energy exchange due to mass transfer

Figure 2 — Energy balance for layer i

The energy balance for layer i is calculated by Formula (1):

$$m_i c_p \left(\vartheta_{t+1,i} - \vartheta_{t,i}\right) = Q_{t+1,i} + \Delta m_t * c_{w,p}\left(\vartheta_{t,i-1} - \vartheta_i\right) + H_{TR,i+1}\left(\vartheta_{t,i+1} - \vartheta_{t,i}\right) - Q_{sto,ls}(i) - H_{TR,i}\left(\vartheta_{t,i} - \vartheta_{t,i-1}\right) \quad (1)$$

where

Key 1	$m_i c_{p;w}\ (\vartheta_{t+1,i} - \vartheta_{,i})$	is the variation of the enthalpy of the layer i;
Key 5	$Q_{t+1,i}$:	is the energy input to the layer i;
Key 6	$\Delta m_t \cdot c_p\ (\vartheta_{t,i-1} - \vartheta_{t;i})$	is the variation of enthalpy due to mass transfer with temperature of the underlying layer;
Key 2	$H_{TR,\ i}(\vartheta_{,i} - \vartheta_{t,i-1})$	is the energy exchange due to conduction with the lower layer;
Key 4	$H_{TR,\ i+1}\ (\vartheta_{t,i+1} - \vartheta_{t,i})$	is the energy exchange due to conduction with the upper layer;
Key 3	$Q_{sto,ls}(i)$	is the contribution of the layer i to the thermal losses of the storage unit.

NOTE H_{TR} is not characterized in the standardized tests and is neglected in the calculation. Consequences for neglecting conduction transfer between layers will result to suppress the thermal interaction between the different layers used in the method A; these thermal transfers impact the temperatures as the thermal stratification is reduced. The energy balance at the storage level is respected.

6 Calculation method

6.1 Output data

The output data of this method are listed in Tables 3 and 4.

Table 3 — Output data of method A

Name	Symbol	Computed symbol	Unit	Intended destination
Energy supplied by storage to the distribution system (expressed per service X)	$Q_{X;sto;out}$	Q_X_sto_out	kWh	M3–1 M8–1
Energy input to the storage from the generation system	$Q_{H;sto;X;in}$	Q_H_sto_X_in	kWh	M3–1 M8–1
Heat losses	$Q_{H;sto;ls}$	Q_H_sto_ls	kWh	M2–2
Heat losses location (thermal zone identifier)	Z_{th}	Z_th	ID	M2-2
Energy deficiency to be supplied by other systems (if available)	$Q_{X;sto;nsup}$	Q_X_sto_nsup	kWh	M3–1 M8-1
Temperature (s) of the volume (s) of the storage unit	$\vartheta_{sto;vol,i}$	theta_sto_vol_i	°C	M3-7 M8–7
Temperature at the output of the solar loop heat exchanger (inlet to the solar loop)	$\Theta_{sol;loop;in}$	Theta_sol_loop_in	°C	M3–8-3 M8–8-3
Temperature at the output of the heater heat exchanger (return to generator)	$\vartheta_{Hc;RT}$	Theta_Hc_RT	°C	M3–1 M8–1
Mean temperature in the heater heat exchanger	$\vartheta_{Hc;mn}$	Theta_Hc_mn	°C	M3–1 M8–1

Table 4 — Output data of method B

Name	Symbol	Computed symbol	Unit	Intended destination
Energy supplied by storage to the distribution system (expressed per service X)	$Q_{X;sto;out}$	Q_X_sto_out	kWh	M3–1 M8–1
Energy input to the storage from the generation system	$Q_{H;sto;X;in}$	Q_H_sto_X_in	kWh	M3–1 M8–1
Heat losses location (thermal zone identifier)	Z_{th}	Z_th	ID	M2-2
Heat losses	$Q_{H;sto;ls}$	Q_H_sto_ls	kWh	M2–2
Energy deficiency to be supplied by other systems (if available)	$Q_{X;sto;nsup}$	Q_X_sto_nsup	kWh	M3–1 M8-1
Temperature (s) of the volume (s) of the storage unit	ϑ_{sto}	theta_sto	°C	M3-7 M8–7