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Energy performance of buildings — Energy requirements and efficiencies of heating, cooling and domestic hot water (DHW) distribution systems —

Part 1: Calculation procedures

Performance énergétique des bâtiments — Besoins énergétiques et rendements des systèmes de distribution d'eau chaude sanitaire, chauffage et refroidissement —

Partie 1: Modes opératoires de calcul

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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 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.

This document was prepared by Technical Committee ISO/TC 205, *Building environment design*.

A list of all parts in the ISO 52032 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.

Introduction

This document belongs to the family of International Standards aimed at the international harmonization of the methodology for assessing the energy performance of buildings. Throughout, this group of standards is referred to as a “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. For the correct use of this document a template is given in Annex A to specify these choices. Default choices are provided in Annex B.

The main target groups of this document are all the users of the set of EPB set of standards (e.g. architects, engineers, regulators).

Further target groups are parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

More information is provided in ISO/TR 52032-2 [12][1)] and in CEN/TR 15316-6-3[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 1 In 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 can cover more than one module and one module can be covered by more than one EPB standard, e.g. a simplified and a detailed method respectively. See also Clause 2 and Tables A.1 and B.1.

1) Under preparation. Stage at the time of publication: ISO/AWI TR 52032-2.

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 (DHW)	Lighting	Building automation and control	Electricity production
sub1		M1	sub1	M2	sub1		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	**ISO 52032-1** (this document)	**ISO 52032-1** (this document)				**ISO 52032-1** (this document)			
7	Aggregation of energy services and energy carriers		7	Internal heat gains	7	Storage and control									

Table 1 *(continued)*

Overarching			Building (as such)		Technical building systems										
	Descriptions			Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot water (DHW)	Lighting	Building automation and control	Electricity production
sub1		M1	sub1	M2	sub1		M3	M4	M5	M6	M7	M8	M9	M10	M11
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									
11	Inspection		11	Inspection	11	Inspection									

Table 1 *(continued)*

Overarching			Building (as such)		Technical building systems										
	Descriptions			Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot water (DHW)	Lighting	Building automation and control	Electricity production
sub1		M1	sub1	M2	sub1		M3	M4	M5	M6	M7	M8	M9	M10	M11
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															

Energy performance of buildings — Energy requirements and efficiencies of heating, cooling and domestic hot water (DHW) distribution systems —

Part 1: Calculation procedures

1 Scope

This document specifies the energy performance calculation of water-based distribution systems for space heating, space cooling and domestic hot water (DHW).

This document is applicable to the heat flux from the distributed water to the space and the auxiliary energy of the related pumps.

The heat flux and the auxiliary energy for pumps can be calculated for any time interval (hour, month and year). The input and output data are mean values of the time interval.

Instead of calculating the energy performance of water-based distribution systems, it is also possible to use measurements as long as they follow the time intervals of the whole performance calculation or can be divided into those time intervals.

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 performance of buildings and building components — Physical quantities and definitions*

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

ISO 52031, *Energy performance of buildings — Method for calculation of system energy requirements and system efficiencies — Space emission systems (heating and cooling)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 52000-1 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
tapping profile
domestic hot water (DHW) drawn off over time

3.2
setback mode
operation mode for pumps at the end of scheduled usage time

3.3
boost mode
operation mode for pumps before the beginning of scheduled usage time

3.4
EPB standard
standard that complies with the requirements given in ISO 52000-1, CEN/TS 16628[5] and CEN/TS 16629[6]

Note 1 to entry: These three basic EPB documents were developed under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480), and support essential requirements of EU Directive 2010/31/EC on the energy performance of buildings (EPBD). Several EPB standards and related documents are developed or revised under the same mandate.

[SOURCE: ISO 52000-1:2017, 3.5.14.]

4 Symbols, subscripts and abbreviated terms

4.1 Symbols

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

Symbol	Description	Unit
b	factor for pump design selection	-
B	width	m
c	specific heat	Wh/(kg·K)
C	constant	-
d	diameter	m
f	resistance ratio	-
F	force	N
h	total surface coefficient of heat transfer	W/(m·K)
H	height	m
L	length	m
m	mass	kg
n	number	-
p	differential pressure	kPa
P	power	N
q	heat flowrate	W/K
Q	heat flow	kWh
R	pressure loss per m	kPa/m
t	time	h
v	flowrate	m^3/h
V	volume	m^3
W	energy demand	kWh
z	depth	m
β	mean part load in a time interval	-
ε	expenditure energy factor	-
θ	temperature	C°

Symbol	Description	Unit
λ	thermal conductivity	W/(m·K)
ρ	density	kg/m^3
Ψ	linear thermal transmittance	W/(m·K)
V_{Tap}	tapping profile	24 [1/h] – per day

4.2 Subscripts

For the purposes of this document, the subscripts given in ISO 52000-1 and the following apply.

a	outer	add	additional	ah	ambient heating
amb	ambient	an	regular mode	aux	auxiliary
avg	average	atap	after tapping	boost	boost heating
		C	cooling	ci	calculation interval
comp	components	corr	correction	cs	conditioned space
D	insulation	des	design	dis	distribution
e	efficiency	el	existing	em	embedded
equi	equivalent	fl	floor	H	heating
HB	hydraulic balance	HC	heating/cooling	HCW	heating/cooling/domestic hot water (DHW)
hydr	hydraulic			*i*	variable
		in	input	ir	inner
j	zone index	ls	loss	mean	mean
nom	nominal heat loss	non	non-insulated	op	operation
out	output	p	pipe	pmp	pump
P1	pump control system #1	P2	pump control system #2	rbl	recoverable
ref	reference	rib	ribbon	rvd	recovered
setb	setback mode	stub	open circuited stubs	w	water
				W	DHW

4.3 Abbreviated terms

DHW	domestic hot water (system)

5 General description of the method — Output of the method

This method covers the calculation of:

— thermal loss of the distribution system for space heating, space cooling and domestic hot water (DHW) in the zone;

— recoverable thermal loss for space heating, space cooling and DHW in the zone;

— auxiliary energy demand of distribution systems;

— recoverable auxiliary energy in the zone for space heating, space cooling and DHW in the zone;

— recovered auxiliary energy in the fluid in the zone for space heating, space cooling and DHW in the zone.

The time interval of the output can be according to the time interval of the input values:

— hourly;

— monthly;

— yearly.

All input and output values are mean values in the corresponding time interval. Because of summarized time intervals with the same boundary conditions and no dynamic effect being taken into account, the bin-method is also valid.

6 Calculation of heat losses and auxiliary energy of distribution systems

6.1 Output data

The output data of this method are listed in Table 2.

Table 2 — Output data of this method

Description	Symbol	Unit	Validity interval[a]	Intended destination module	Varying[b]
Thermal loss of the distribution system for heating in the zone	$Q_{H,dis,ls}$	kWh	0 to ∞	M3–1	Yes
Thermal loss of the distribution system for cooling in the zone	$Q_{C,dis,ls}$	kWh	0 to ∞	M4–1	Yes
Thermal loss of the distribution system for DHW in the zone	$Q_{W,dis,ls}$	kWh	0 to ∞	M3–1	Yes
Recoverable thermal loss of the distribution system for heating in the zone	$Q_{H,dis,rbl}$	kWh	0 to ∞	M3–1	Yes
Recoverable thermal loss of the distribution system for cooling in the zone	$Q_{C,dis,rbl}$	kWh	0 to ∞	M4–1	Yes
Recoverable thermal loss of the distribution system for DHW in the zone	$Q_{W,dis,rbl}$	kWh	0 to ∞	M3–1	Yes
Auxiliary energy for distribution system heating in the zone	$W_{H,dis}$	kWh	0 to ∞	M3–1	Yes
Auxiliary energy for distribution system cooling in the zone	$W_{C,dis}$	kWh	0 to ∞	M4–1	Yes
Auxiliary energy for distribution system DHW in the zone	$W_{W,dis}$	kWh	0 to ∞	M3–1	Yes
Recoverable auxiliary energy for distribution system heating in the zone	$Q_{H,dis,rbl}$	kWh	0 to ∞	M3–1	Yes
Recoverable auxiliary energy for distribution system cooling in the zone	$Q_{C,dis,rbl}$	kWh	0 to ∞	M4–1	Yes
Recoverable auxiliary energy for distribution system DHW in the zone	$Q_{W,dis,rbl}$	kWh	0 to ∞	M3–1	Yes
Recovered auxiliary energy for distribution system heating in the zone	$Q_{H,dis,rvd}$	kWh	0 to ∞	M3–1	Yes
Recovered auxiliary energy for distribution system cooling in the zone	$Q_{C,dis,rvd}$	kWh	0 to ∞	M4–1	Yes

[a] Practical range, informative.

[b] "Varying": value can vary over time; different values per time interval, e.g. hourly values or monthly values (not constant values over the year).

Table 2 *(continued)*

Description	Symbol	Unit	Validity interval[a]	Intended destination module	Varying[b]
Recovered auxiliary energy for distribution system DHW in the zone	$Q_{W,dis,rvd}$	kWh	0 to ∞	M3–1	Yes

[a] Practical range, informative.

[b] "Varying": value can vary over time; different values per time interval, e.g. hourly values or monthly values (not constant values over the year).

6.2 Calculation time intervals

The methods described in Clause 6 are suitable for the following calculation time intervals:

— hourly;

— monthly;

— yearly.

For this method, the output time interval is the same as the input time-interval. This method does not take into account any dynamic effect.

6.3 Input data

6.3.1 Product technical data (quantitative)

Table 3 — Product technical input data list

Characteristics	Symbol	Catalogue unit	Computed unit	Validity interval[a]	Ref.	Varying[b]
Energy efficiency index	EEI		-	0 to 1		YES

[a] Practical range, informative.

[b] "Varying": value can vary over time; different values per time interval, e.g. hourly values or monthly values (not constant values over the year).

6.3.2 Configuration and system design data

6.3.2.1 Process design

The input data of the process design are listed in Table 4.

Table 4 — Process design input data list

Process design		
tapping profile	V_{tap}	24 · [l/h]
temperature difference between hot water tapping temperature to the return temperature in a circulation loop system (design value)	$\Delta\vartheta W$	°C
number of operations of circulation pump	n_{nom}	1/d
average hot water temperature in circulation system without operation	$\vartheta_{W,avg}$	°C
resistance ratio of components in the piping system	f_{comp}	—
pressure loss per length	$R_{HCW,max}$	kPa/m
pressure losses of additional resistances	$\Delta R_{HCW,add}$	kPa
length of pipes	L	m