
Energijske lastnosti stavb - Metoda za izračun energijskih zahtev in učinkovitosti sistema - 4-2. del: Sistemi za pridobivanje toplote za ogrevanje, toplotne črpalke - Modula M3-8-2 in M8-8-2

Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2

Energetische Bewertung von Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 4-5: Wärmeerzeugung für die Raumheizung, Wärmepumpensysteme, Module M3-8-2, M8-8-2

Performance énergétique des bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 4-2: Systèmes de génération de chauffage des locaux, systèmes de pompes à chaleur Module M3-8-2, M8-8-2

Ta slovenski standard je istoveten z: prEN 15316-4-2

ICS:

27.080	Toplotne črpalke	Heat pumps
91.140.10	Sistemi centralnega ogrevanja	Central heating systems

oSIST prEN 15316-4-2:2022**en,fr,de**

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

DRAFT
prEN 15316-4-2

March 2022

ICS 91.140.10

English Version

**Energy performance of buildings - Method for calculation
of system energy requirements and system efficiencies -
Part 4-2: Space heating generation systems, heat pump
systems, Module M3-8-2, M8-8-2**

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Energetische Bewertung von Gebäuden - Verfahren zur
Berechnung der Energieanforderungen und
Nutzungsgrade der Anlagen - Teil 4-5:
Wärmeerzeugung für die Raumheizung,
Wärmepumpensysteme, Module M3-8-2, M8-8-2

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 foreword

This document (prEN 15316-4-2:2022) 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 supersedes EN 15316-4-2:2017.

The main changes compared to EN 15316-4-2:2017 are:

- 1) inclusion of more types of heat pumps, such as air to air (direct expansion);
- 2) method B has been withdrawn;
- 3) path A and path B have been reviewed and integrated into a unique frame;
- 4) 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.

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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 how to calculate the energy performance of heat pump systems used for domestic hot water preparation or space heating purpose.

This document also includes direct expansion and/or condensation systems.

For the correct use of this standard, 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.

1 Scope

This document cover heat pumps for space heating, domestic hot water production and alternate operation, where the same heat pump delivers the heat to cover the space heating and domestic hot water heat requirement.

The document provides a calculation method under steady conditions that corresponds to one calculation interval.

This calculation is intended to be connected to the whole building calculation model and takes in account the external conditions and building controls that influence the energy requirements for heating supplied by the heat pump system.

The scope of this standard is to standardize the:

- required inputs;
- calculation methods;
- required outputs;

of the generation for space heating and domestic hot water production of the following heat pump systems:

- electrically-driven vapour compression cycle (VCC) heat pumps;
- combustion engine-driven vapour compression cycle heat pumps;
- thermally-driven vapour absorption cycle (VAC) heat pumps,

using combinations of heat source and heat sink listed in Table 1.

Table 1 — Heating sources and sinks

Source	Sink
Outdoor air	Indoor air
Exhaust-air	Ducted air
Indirect ground source with brine	Technical water
Indirect ground source with water	Domestic hot water
Direct ground source (DX, direct expansion)	
Surface water	
Ground water	

This document does not cover sizing or inspection of heat pumps.

Heat pumps for cooling systems are taken into account in module M4-8. Other generation systems such as boilers are covered in other sub modules of part M3-8.

Table 2 shows the relative position of this standard within the set of EPB standards in the context of the modular structure as set out in EN ISO 52000-1.

NOTE 1 The same table can be found in CEN ISO/TR 52000-2, with, for each module, the numbers of the relevant EPB standards and accompanying technical reports that are published or in preparation.

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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 2 — Position of this standard, 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	Electricity production	
sub	M1		sub	M2	sub		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 Energy Carriers		7	Internal Heat Gains	7	Storage and control										
8	Building Partitioning		8	Solar Heat Gains	8	Generation										
					8-1	Combustion boilers										
					8-2	Heat pumps	15316-4-2					15316-4-2				
					8-3	Thermal solar Photovoltaics										
					8-4	On-site cogeneration										
					8-5	District heating and cooling										

Overarching			Building (as such)		Technical Building Systems										
	Descriptions			Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation	Electricity production
sub	M1		sub	M2	sub		M3	M4	M5	M6	M7	M8	M9	M10	M11
					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									
12	Ways to Express Indoor Comfort		12	-	12	BMS									
13	External Environment Conditions														
14	Economic Calculation														

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 14511 (all parts), *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling*

EN 14825, *Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling — Testing and rating at part load conditions and calculation of seasonal performance*

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)*

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Additional references are identified by the EPB module code number and are specified in Annex B, Table B.1 (informative default references) according to the template given in Annex A, Table A.1 (normative template with list of required references).

3 Terms and definitions

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

3.1**heat pump**

appliance which takes up heat at a certain temperature and releases heat at a higher temperature

Note 1 to entry: When operated to provide heat (e.g., for space heating or water heating), the appliance is said to operate in the heating mode; when operated to remove heat (for example, for space cooling), it is said to operate in the cooling mode.

3.2**electrically driven heat pump**

vapour compression cycle heat pump, which incorporate a compressor that is driven by an electric motor

3.3**gas absorption heat pump**

heat pump working with a thermodynamic cycle that uses ammonia as a refrigerant and water as absorber, powered through a combustion direct flame

3.4**combustion engine heat pump**

compressed vapour heat pump driven by a combustion engine

3.5**heat transfer medium**

any medium (water, air, etc.) used for the transfer of heat within the system and from the system to the serviced area, that can be:

- the fluid cooled by the evaporator;
- the fluid heated by the condenser

Note 1 to entry: Expressed in °C.

3.6**operating range**

range indicated by the manufacturer and limited by the upper and lower limits of use (e.g. temperatures, air humidity, voltage) within which the unit is deemed to be fit for use and has the characteristics published by the manufacturer

3.7**heat output**

heat produced by the heat pump system to cover the energy requirement of the distribution subsystem and the generation subsystem heat losses for space heating and/or domestic hot water

Note 1 to entry: heat output is an energy, heat power output is the corresponding power

Note 2 to entry: heat power output is the same as heat capacity

3.8**heat power output**

heat flow rate given off by the unit to the heat transfer medium per unit of time for heating or domestic hot water or a combination of these

Note 1 to entry: If heat is removed from the indoor heat exchanger for defrosting, it is taken into account.

3.9**part load operation**

operation state of the heat pump where the actual required heat power output (applied load) is less than the maximum power output of the device

3.10**part load ratio**

ratio between the generated heat during the calculation period and the maximum possible output from the heat generator during the hourly calculation period or bin temperature

Note 1 to entry: modified definition from EN 14825

Note 2 to entry: this is not an information about the actual operation of the heat pump in the calculation interval. This is an information about test conditions of product technical data declared according to EN 14825.

3.11**load ratio**

ratio of the actual heat power output divided by the maximum power output of the heat pump at the same source and sink temperature conditions

3.12**intermittency ratio**

when cycling ON-OFF, ratio of ON time t_{ON} to total time available for operation t_{pi} .

Note 1 to entry: For a modulating heat pump, the intermittency ratio IR is 1,0 when the required heat output is greater than or equal to the minimum continuous operation power output of the heat pump.

Note 2 to entry: For an ON-OFF heat pump, the intermittency ratio IR is equal to the load ratio LR.

Note 3 to entry: This is the same as the capacity ratio (CR) defined in EN 14825.

3.13**alternate operation**

production of heat energy for the space heating and domestic hot water system by a heat generator with combined service by switching the heat generator either to the domestic hot water operation or the space heating operation

3.14**auxiliary energy**

electrical energy used by technical building systems for heating, cooling, ventilation and/or domestic water to support energy transformation and transport to satisfy energy needs

Note 1 to entry: This includes energy for fans, pumps, electronics, etc. Electrical energy input to a ventilation system for air transport and heat recovery is not considered as auxiliary energy, but as energy use for ventilation.

Note 2 to entry: The driving energy input for electrically driven heat pumps in the system boundary of the COP and an electrical back-up heater is not entitled auxiliary energy.

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3.15**external auxiliary energy**

auxiliary energy used by the heat pump which is not accounted for in the testing of the COP

3.16**internal auxiliary energy**

auxiliary energy used by the heat pump which is already accounted for in the testing of the COP

3.17**primary pump**

pump mounted in the circuit containing the generator and hydraulic decoupling, e.g. a heating buffer storage in parallel configuration or a hydronic distributor

3.18**back-up heater**

heater to supply heat not covered by the heat pump system itself

Note 1 to entry: If the back-up heater is an electrical heater, the system is calculated according to this standard, if it is external system, this standard gives the demand of missing heat not supplied by the heat pump as output data.

3.19**coefficient of performance**

ratio of the heat power output to the effective power input of the unit

3.20**bivalent temperature**

lowest outdoor temperature point at which the unit is declared to have a capacity able to meet 100 % of the heating load without supplementary heater, whether it is integrated in the unit or not

Note 1 to entry: Below this point, the unit may still provide capacity, but additional supplementary heating is necessary to fulfil the full heating load.

Note 2 to entry: Bivalent temperature does not apply to units.

Note 3 to entry: This is the definition used to

3.21**operation limit temperature**

outdoor temperature below which the declared capacity is equal to zero

3.22**off mode**

mode wherein the unit is completely switched off and cannot be reactivated by control device, external signal or by a timer

Note 1 to entry: Off mode means a condition in which the equipment is connected to the mains and is not providing any function. The following will also be considered as off mode: conditions providing only an indication of off mode condition; conditions providing only functionalities intended to ensure electromagnetic compatibility.

3.23**stand-by mode (thermostat off mode)**

mode wherein the unit is switched off partially and can be reactivated by a control device (such as a remote control), an external signal or a timer

Note 1 to entry: The unit is connected to the mains, depends on signal input to work as intended and provides only the following functions, which may persist for an indefinite time: reactivation function, or reactivation function and only an indication of enabled reactivation function, and/or information or status display.

3.24

crank-case heating mode

mode wherein the unit is switched off partially and can be reactivated by a control device (such as a remote control), an external signal or a timer, taking into account energy for crankcase heating

Note 1 to entry: The unit is connected to the mains, depends on signal input to work as intended and provides only the following functions, which may persist for an indefinite time: reactivation function, or reactivation function and only an indication of enabled reactivation function, and/or information or status display.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in EN ISO 52000-1, and the specific terms listed in Table 3 apply.

Table 3 — Symbols

Symbol	Units	Description
COP	-	Coefficient of performance
CR	-	Capacity ratio
IR	-	Intermittency ratio
LR	-	Load ratio
ΔT	K	Temperature difference

4.2 Subscripts

For the purposes of this document, the subscripts given in EN ISO 52000-1, and the specific subscripts listed in Table 4 apply.

Table 4 — Subscripts

ci	calculation interval i	duct	duct	ONOF	ON-OFF operation
mi	month i	e	external, outdoors, evaporator	opt	optimal
pi	priority i	elec	electric	p	pressure
i	generic index	em	emitter	Pn	at nominal power
j	generic index	eq	equivalent	rec	recovery
0	at zero output	exer	exergetic	ref	reference
add	additional	ext	external	req	required
air	air	gdx	direct expansion ground heat exchanger	sby	stand-by