SLOVENSKI STANDARD
oSIST prEN 15316-4-2:2014

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Ogrevalni sistemi v stavbah - Metoda za preračun energijskih zahtev in učinkovitosti sistema - 4-2. del: Sistemi za ogrevanje prostora, toplotni črpalni sistemi

Heating systems and water based cooling systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems

Heizungsanlagen und wasserbasierte Kühlanlagen in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 4-2: Wärmeerzeugung für die Raumheizung, Wärmepumpensysteme

Systèmes de chauffage et systèmes de refroidissement à eau dans les 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

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27.080	Toplotne črpalke	Heat pumps
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Heating systems and water based cooling systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems

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

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

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Contents

Foreword

This document (prEN 15316-4-2:2014) 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 is currently submitted to the CEN Enquiry.

This document will supersede EN 15316-4-2:2008.

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

Introduction

This standard is part of a package developed to support EPBD[1)] 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.

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

— energy performance calculation for heating systems;

— inspection of heating systems;

— design of heating systems;

— installation and commissioning of heating systems.

This standard specifies to take into account the energy performance of heat pump systems used for domestic or heating purpose.

This updated standard covers hourly and monthly time-step.

Figure 1 shows the relative position of this standard within the EPB standards.

1) Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast)

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	sub1	M2	sub1		M3	M4	M5	M6	M7	M8	M9	M1 0	M11
1	General		1	General	1	General	15316-1					15316-1			
2	Common terms and definitions; symbols, units and subscripts		2	Building Energy Needs	2	Needs						12831-3 ?			
3	Applications		3	(Free) Indoor Conditions without Systems	3	Maximum Load and Power	12831-1					12831-3			
4	Ways to Express Energy Performance		4	Ways to Express Energy Performance	4	Ways to Express Energy Performance	15316-1					15316-1			
5	Building Functions and Building Boundaries		5	Heat Transfer by Transmission	5	Emission & control	15316-2	15316-2							
6	Building Occupancy and Operating Conditions		6	Heat Transfer by Infiltration and Ventilation	6	Distribution & control	15316-3	15316-3				15316-3			
7	Aggregation of Energy Services and Energy Carriers		7	Internal Heat Gains	7	Storage & control	15316-5					15316-5 15316-4-3			
8	Building Partitioning		8	Solar Heat Gains	8	Generation									
					8-1	Combustion boilers	15316-4-1					15316-4-1			
					8-2	Heat pumps	**15316-4-2**	**15316-4-2**				**15316-4-2**			
					8-3	Thermal solar Photovoltaics	15316-4-3					15316-4-3			15316-4-3
					8-4	On-site cogeneration	15316-4-4					15316-4-4			15316-4-4
					8-5	District heating and cooling	15316-4-5	15316-4-5							15316-4-5
					8-6	Direct electrical heater	15316-4-6					15316-4-6			
					8-7	Wind turbines									15316-4-7
					8-8	Radiant heating, stoves	15316-4-8								
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													

Figure 1 — Position of EN 15316-4-2 within the modular structure

1 Scope

The standard covers heat pumps for space heating, heat pump water heaters (HPWH) and heat pumps with combined space heating and domestic hot water production in alternate or simultaneous operation, where the same heat pump delivers the heat to cover the space heating and domestic hot water heat requirement.

The standard provides a calculation method under steady conditions that corresponds to one calculation step.

The results of this calculation are incorporated in larger building models and take in account the influence of the external conditions and building control that influence the energy requirements for heating supplied by the heat pump system.

The scope of this part is to standardise the:

— required inputs;

— calculation methods;

— required outputs

for output thermal power generation for space heating and domestic hot water production of the following heat pump systems, including control:

— 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 distribution listed in Table 1.

Table 1 — Heating sources and energy distribution

Source	Distribution
Outdoor air	~~**Air**~~
Exhaust-air	**Water**
Indirect ground source with brine distribution	**Direct condensation/evaporation of the refrigerant in the appliance**
Indirect ground source with water distribution	
Direct ground source (Direct expansion (DX)	
Surface water	
Ground water	

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

This standard deals with heat generators for heating or for combined domestic hot water and heating service. Generators for domestic hot water only are taken into account into module M8-8.

NOTE 1 Heat pumps generators for cooling systems are taken into account into module M4-8.

NOTE 2 Heat pumps generators for space heating using air (distribution) are taken into account in module M5-8.

Other generation systems such as boilers are covered in other sub modules of part M3-8.

This is the revision of EN 15316-4-2:2008. The revision covers the adaptation of the standard to hourly and monthly energy calculation.

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.

prEN 15603:2013, *Energy performance of buildings — Overall energy use and definition of energy ratings.*

EN 15316-1, *Heating systems and water based cooling systems in buildings — Method for calculation of system energy requirements and system efficiencies — Part 1: General and Energy performance expression*

EN 15450, *Heating systems in buildings — Design of heat pump heating systems*

EN 12309-2, *Gas-fired absorption and adsorption air-conditioning and/or heat pump appliances with a net heat input not exceeding 70 kW — Part 2: Rational use of energy*

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 15879-1, *Testing and rating of direct exchange ground coupled heat pumps with electrically driven compressors for space heating and/or cooling — Part 1: Direct exchange-to-water heat pumps*

EN 16147, *Heat pumps with electrically driven compressors — Testing and requirements for marking for domestic hot water units*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, prEN 15603:2013 and the following specific definitions apply.

3.1
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

3.2
application rating conditions
mandatory rated conditions within the operating range of the unit that are published by the manufacturer or supplier

3.3
auxiliary energy
electrical energy used by technical building systems for heating, cooling, ventilation and/or domestic water to support energy transformation to satisfy energy needs

Note 1 to entry: This includes energy for fans, pumps, electronics, etc. Electrical energy input to the a ventilation system for air transport and heat recovery is not considered as auxiliary energy, but as energy use for ventilation (C.4.18).

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.

3.4
bivalent (balance point) temperature
temperature at which the heat pump heating power and the building heat load are equal

3.5
bin
a statistical temperature class (sometimes a class interval) for the outdoor air temperature, with the class limits expressed in a temperature unit

3.6
coefficient of performance COP
ratio of the heating capacity to the effective power input of the unit

3.7
cut-out period
time period in which the electricity supply to the heat pump is interrupt by the supplying utility

3.8
effective power input
average power input of the unit within the defined interval of time obtained from:

— the power input for operation of the compressor or burner and any power input for defrosting;

— the power input for all control and safety devices of the unit; and

— the proportional power input of the conveying devices (e.g. fans, pumps) for ensuring the transport of the heat transfer media inside the unit

3.9
electrically-driven heat pump
in the frame of this standard, electrically-driven heat pumps denote vapour compression cycle heat pumps, which incorporate a compressor that is driven by an electric motor

3.10
combined heat pump
heat generator, which supplies energy to two different systems, e.g. the space heating system and the domestic hot water system in alternate or simultaneous combined operation

3.11
heat pump
unitary or split-type assemblies designed as a unit to transfer heat. It includes a vapour compression refrigeration system or a refrigerant/sorbent pair to transfer heat from the source by means of electrical or thermal energy at a high temperature to the heat sink

3.12
heat transfer medium
any medium (water, air, etc.) used for the transfer of the heat without change of state. It can be:

— the fluid cooled by the evaporator;

— the fluid heated by the condenser

3.13
heating power $P_{HW;gen;out}$
heat flow rate given off by the unit to the heat transfer medium per unit of time for heating, or domestic hot water of combination of these

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

3.14
operation temperature limit (*TOL*)
temperature at which heat pump operation is stopped and the total heat requirements are covered by a back-up heater

3.15
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

3.16
part load operation
operation state of the heat pump system where the actual load requirement is below the actual output capacity of the device

3.17
part load ratio
the 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: Part load ratio is not used for monthly method.

3.18
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

3.19
produced heat
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

3.20
set-point temperature of a conditioned zone
Indoor (minimum intended) temperature, as fixed by the control system in heating mode

3.21
simultaneous operation during the heating period
simultaneous production of heat energy for the space heating and domestic hot water use by a combined heat pump

3.22
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.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in prEN 15603:2013 apply.

4.2 Subscripts

For the purposes of this document, the subscripts given in prEN 15603:2013, and the specific subscripts listed in Table 2 apply.

Table 2 —Subscripts

Pd	at P design	eng	Engine	Pn	At nominal power
BU	Back up	stbl	Stand by	P0	At zero load
OL	Operative limit	biv	Bivalent	Pint	At intermediate load
LRxx	Part load ratio xx%	comp	Compressor	gen	Generation
Cont	Continuous	add	additionnal	dgn	Design
Sys	System				

5 Description of the methods

5.1 General

These methods (hourly, monthly) cover the calculation of energy input, renewable energy, auxiliary energy and recoverable losses of heat pump for heating and/or domestic hot water.

The time step of the output can be:

— hourly;

— bin;

— monthly,

according to the time-step of the input.

Heat pump performance strongly depends on the operating conditions, basically the source and the sink temperature. As source and sink temperatures vary over the heating periods and the year, the heat pump performance shall be calculated according with an adapted step period, in line with the climatic data used. As default a step time of one hour is considered in this standard.

The time step shall be adapted to according to the climatic data available and the accuracy required for the calculation

NOTE For some alternative methods, calculation periods are not oriented at the time scale, i.e. monthly values, but on the frequency of the outdoor air temperature (bin method). This method is described in EN 14825.

5.2 Output data of the method

The output data of this method are listed in Table 3. These output data are identical for all time steps.

Table 3 — Output data of this method:

Description	Symbol	Unit	Intended destination module
Generation input	$E_{H,gen,in}$	kWh	M3-1
Recoverable heat	$Q_{H,gen,ls,rbl}$	kWh	M2-2
Renewable energy input[a]	$Q_{H,gen,ren,in}$ [a]	kWh	M3-1
Total auxiliary energy	$W_{H,gen,aux}$	kWh	M3-1
Fuel type	HP_FUEL	List	M3-1
Back up energy	$E_{H,gen,bu,in}$	kWh	M3-1
Fuel type for back-up	HP_BU_FUEL	List	M3-1
Heat pump type	HP_TYP	List	M3-1
Energy delivered for heating	$Q_{H,gen,out}$	kWh	M3-6
Energy delivered for Domestic Hot Water	$Q_{W,gen,out}$	kWh	M8-7
Energy delivered for storage heating	$Q_{H,gen,sto,out}$	kWh	M3-7
Additionnal energy needed for heating	$Q_{H,X,out,add}$	kWh	M3-1
Additionnal energy need for domestic hot water	$Q_{,W,X,out,add}$	kWh	M8-1
Driven energy	HP_FUEL_TYPE	List	M3-1

[a] Energy input could also be recovered from internal air; in this case the symbol attached to recovered energy input is changed into $Q_{H,gen,rvd,in}$.

Generation input $E_{H,gen,in}$ is the fuel required by the heat pump in the calculation interval.

Recoverable heat $Q_{H,gen,ls,rbl}$ is the recoverable heat for heating in the calculation interval.

Renewable input $E_{H,gen,ren,in}$ is the energy input from a renewable source in the calculation interval.

Back-up energy $E_{H,gen,bu,in}$ is the surplus energy needed to satisfy the energy demand when the heat pump is not operating or to cover lack of power capacity from the heat pump.

5.3 Multiple heat generators

Heat pumps systems for heating can be independent or used as part of a system including other generators. Figure 2 explains how the information and output of the calculation are used in such multiple systems. In this case the heat pump, including its integrated back-up system (if any) is considered as the priority generator.

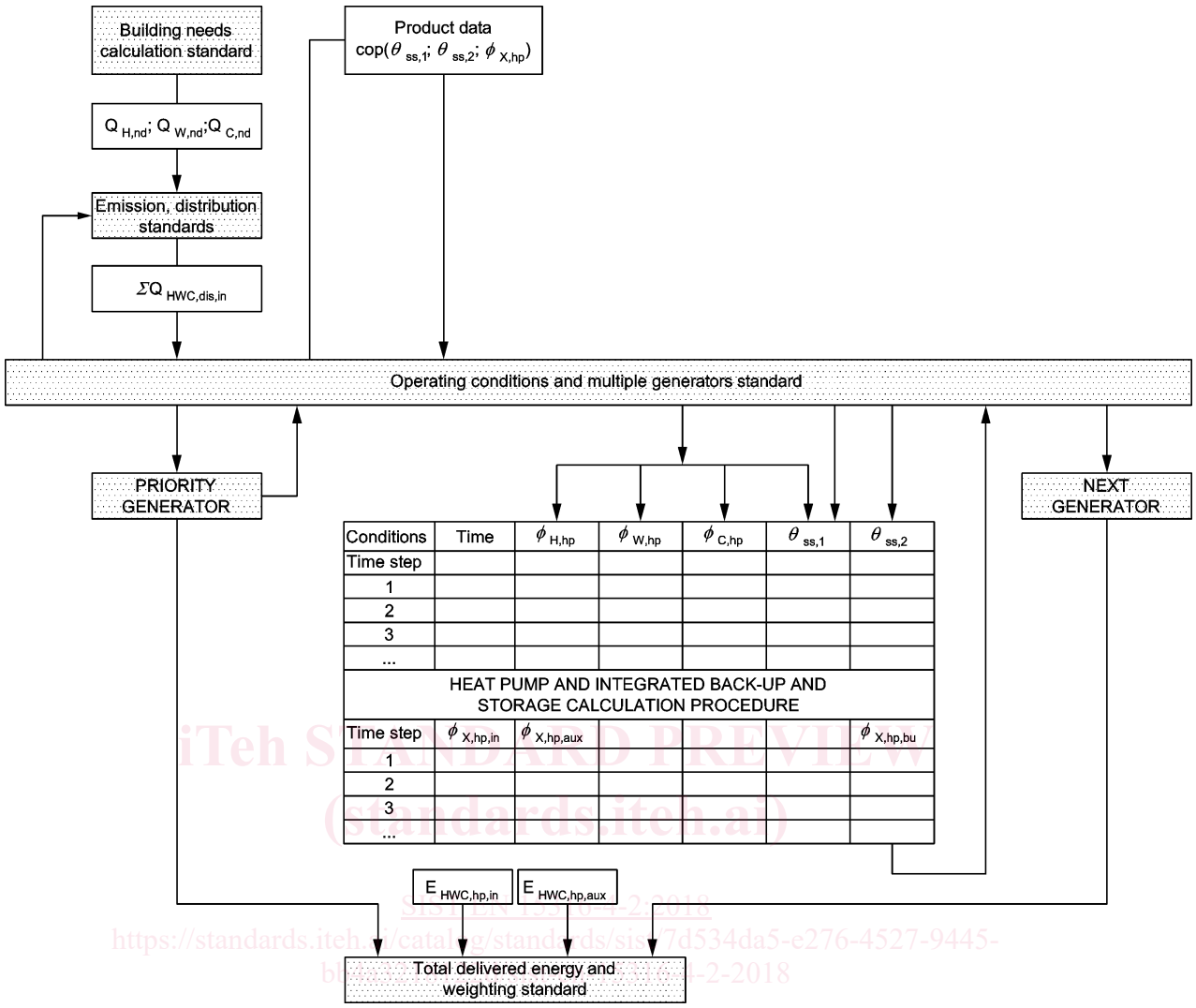

Figure 2— Heat pump systems and interaction with other generators

5.4 System boundary

The system boundary defines the components of the entire heating systems that are considered in this standard. For the heat pump generation subsystem the system boundary comprises the heat pump, the heat source system, attached internal and external storages and attached electrical back-up heaters. Auxiliary components connected to the generation subsystem are considered, as long as no transport energy is transferred to the distribution subsystem. For fuel back-up heaters the required back-up energy is included in the system boundary.

Distribution and emission systems are out of the system boundaries.

Physical factors taken into account:

The calculation method takes into account the following physical factors, which have an impact on the seasonal performance factor and thereby on the required energy input to meet the heat requirements of the distribution subsystem

— type of generator configuration (monovalent, bivalent);

— type of heat pump (driving energy (e.g. electricity or fuel), thermodynamic cycle (VCC, VAC));