SLOVENSKI STANDARD

SIST EN 15450:2007

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Grelni sistemi v stavbah - Naļ rtovanje toplotno ļ rpalnih ogrevalnih sistemov

Heating systems in buildings - Design of heat pump heating systems

Heizsysteme Gebäuden - Planung von Heizsystemen mit Wärmepumpen

Systemes de chauffage dans les bâtiments - Conception des systemes de pompes de chauffage

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27.080	Toplotne ļ rpalke	Heat pumps
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Heating systems in buildings - Design of heat pump heating systems

Systèmes de chauffage dans les bâtiments - Conception des systèmes de chauffage par pompe à chaleur

Heizungsanlagen in Gebäuden - Planung von Heizungsanlagen mit Wärmepumpen

This European Standard was approved by CEN on 26 August 2007.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 15450:2007) has been prepared by Technical Committee CEN/TC 228 “Heating systems in buildings”, the secretariat of which is held by DS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2008, and conflicting national standards shall be withdrawn at the latest by April 2008.

The subjects covered by CEN/TC 228 are the following:

- design of heating systems (water based, electrical etc.);
- installation of heating systems;
- commissioning of heating systems;
- instructions for operation, maintenance and use of heating systems;
- methods for calculation of the design heat loss and heat loads;
- methods for calculation of the energy performance of heating systems.

Heating systems also include the effect of attached systems such as hot water production systems.

All these standards are systems standards, i.e. they are based on requirements addressed to the system as a whole and not dealing with requirements to the products within the system.

Where possible, reference is made to other European or International Standards, a.o. product standards. However, use of products complying with relevant product standards is no guarantee of compliance with the system requirements.

The requirements are mainly expressed as functional requirements, i.e. requirements dealing with the function of the system and not specifying shape, material, dimensions or the like.

The guidelines describe ways to meet the requirements, but other ways to fulfil the functional requirements might be used if fulfilment can be proved.

Heating systems differ among the member countries due to climate, traditions and national regulations. In some cases requirements are given as classes so national or individual needs may be accommodated.

In cases where the standards contradict with national regulations, the latter should be followed.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This standard provides design criteria for heating systems with integrated heat pump systems with respect to:

— heat source;

— electrical supply;

— strategy;

— positioning;

— noise level;

— heat supply;

— sizing.

Energy performance design criteria are dealt with in another document of this technical committee.

1 Scope

This standard specifies design criteria for heating systems in buildings using electrically driven heat pumps alone or in combination with other heat generators. Heat pump systems considered include (see Table 1):

— water – water;

— water – air;

— brine – water;

— refrigerant – water (direct expansion systems);

— refrigerant – refrigerant;

— air – air;

— air – water.

This standard takes into account the heating requirements of attached systems (e.g. domestic hot water) in the design of heat supply, but does not cover the design of these systems. This standard covers only the aspects dealing with the heat pump, the interface with the heat distribution system and heat emission system (e.g. buffering system), the control of the whole system and the aspects dealing with energy source of the system.

Systems designed primarily for cooling and systems which can operate simultaneously in cooling and heating mode are not within the scope of this standard.

Table 1 — Heat pump systems (within the scope)

source-system (energy extraction)		sink-system (energy rejection)	
energy source [a]	**medium** [b]	**medium**	**energy sink** [c]
exhaust air outdoor air	air	air	indoor air
		water	indoor air water
surface water ground water	water	water	indoor air water
		air	indoor air
ground	brine (water)	air	indoor air
		water	indoor air water
	refrigerant	water	indoor air water
		refrigerant	indoor air

[a] Energy source is the location where the energy is extracted.

[b] Medium is the fluid transported in the corresponding distribution system.

[c] Energy sink is the location where the energy is used; this can be the heated space or water in case of domestic hot water production.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 378-1, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Basic requirements, definitions, classification and selection criteria*

EN 12828:2003, *Heating systems in buildings – Design for water-based heating systems*

EN 12831, *Heating systems in buildings - Method for calculation of the design heat load*

EN 14336, *Heating systems in buildings – Installation and commissioning of water based heating systems*

EN 14511-1:2004, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 1: Terms and definitions*

prEN 15316-4-2, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12828:2003 and the following apply.

3.1.1
coefficient of performance (COP)
ratio of the heating capacity to the effective power input of the unit, expressed in Watt/Watt

[EN 14511-1:2004]

3.1.2
seasonal performance factor (SPF)
ratio of the total annual energy Q_{HP} delivered by the heat pump to the distribution subsystem for space heating and/or other attached systems (e.g. domestic hot water) to the total annual input of electrical energy consumed, including the total annual input of auxiliary energy

NOTE See also Annex C.

3.1.3
balance point temperature
lowest design external air temperature at which the heat pump output capacity and the building heating demand (heat load) are equal

NOTE At lower external air temperatures, a second heat generator is employed to cover the entire or part of the building heating demand.

3.1.4
bivalent-alternative mode
operational mode in which a second heat generator (e.g. gas boiler) completely accounts for the heat demand of the heating system if the external temperature falls below the balance point temperature

3.1.5
bivalent-parallel mode
operational mode in which a second heat generator (e.g. gas boiler) accounts for the remaining heat demand of the heating system, which cannot be supplied by the heat pump when the external temperature falls below the balance point temperature

3.1.6
monovalent mode
operational mode in which the heat pump is designed to cover the entire heat demand of the heating system alone

NOTE The heat pump output capacity is at least equal to the design heat load calculated according to EN 12831.

3.1.7
backup heater
supplementary heating which is used to supply heat when the capacity of the heat pump is inadequate

3.2 Symbols, units and abbreviations

For the purposes of this document, the following symbols and units (Table 2) and abbreviations (Table 3) apply.

Table 2 — Symbols and units

Symbol	Description	Unit
C_{ih}	Effective internal heating capacity of the building elements	Wh/m³K
$COP_{\theta set}$	coefficient of performance of the heat pump for domestic hot water demand at the set buffer storage temperature θ_{set}	–
f_{AS}	design factor for attached systems	–
f_{DHW}	design factor for domestic hot water systems	–
f_{HL}	design factor for the heat load	–
$\Phi_{hp,el,\theta set}$	electrical power of the heat pump for domestic hot water demand at θ_{set}	kW
P_{el}	effective electrical power input	kW
Q	energy	kWh
Q_{daily}	total hot water energy demand per day	kWh
Q_S	energy stored in the buffer storage	kWh
Q_{DP}	energy demand during the defined period	kWh
$Q_{l,s}$	heat losses of the buffer storage in a defined time period	kWh
$Q_{s,eff}$	effective (useful) amount of energy in the buffer storage	kWh
$q_{l,s}$	specific daily thermal losses of the buffer storage	kWh/(24h·l)
t_{DP}	duration of the defined period	h
$t_{Energy,HP}$	duration of period when energy is available for the heat pump	h
V_S	volume of buffer storage	l
V_{DP60}	volume delivered during the defined period at 60 °C	l
$V_{l,s}$	volume amounting to the thermal losses of the buffer storage	l
$V_{\Phi set}$	volume of hot water at θ_{set} that has the same enthalpy as QDP	L
Φ_{AS}	heating capacity of attached systems	kW
Φ_{DHW}	heating capacity of the heat pump for domestic hot water use	kW
Φ_{HL}	heat load capacity	kW
$\Phi_{hp,\theta set}$	heating capacity of the heat pump at θ_{set}	kW
Φ_{hp}	heating capacity of the heat pump	kW
Φ_{SU}	heating capacity of the heat supply system	kW
λ	thermal conductivity	W/(mK)
θ_{CW}	inlet temperature (cold water)	°C
θ_{DPset}	set point for temperature in the buffer storage	°C
θ_e	design external air temperature	°C
$\theta_{m,e}$	local mean external air temperature	°C
θ_{min}	minimum value for domestic hot water draught off	°C
θ_{set}	set temperature	°C

Table 3 — Abbreviations

Abbreviation	Description
COP	coefficient of performance
DHW	domestic hot water
GWP	global warming potential
ODP	ozone depletion potential
SPF	seasonal performance factor

4 System design requirements

4.1 General

4.1.1 Basic consideration

The heating system shall be designed according to the requirements stated in 4.1 of EN 12828:2003. The following additional aspects shall be taken into account.

4.1.2 Heat source

4.1.2.1 General design aspects

For each type of heat source, the following design aspects shall be taken into consideration:

— availability of the heat source;

— temperature level of the heat source;

— available heat extraction rate;

— quality of the heat source.

4.1.2.2 Air as heat source

The minimum air flow declared by the manufacturer has to be taken into account when designing the system.

The efficiency and the capacity of the heat pump increases with increasing external air temperature. For monovalent systems, the required capacity of the heat pump shall be determined by using the design external air temperature θ_e in the heat load calculation according to EN 12831. For bivalent systems, a suitable balance point temperature shall be set depending on the selected operational mode (bivalent-alternative or bivalent-parallel mode).

The air entering the evaporator of the heat pump (outdoor air or exhaust air), shall be clean according to the manufacturer's specifications.

4.1.2.3 Water as heat source (e.g. groundwater, seawater, lake, river)

The required water flow rate for the heat pump unit shall be made available, taking into account local regulations which may place limits on availability and flow rates.

The average groundwater temperature can be obtained from local authorities, a test borehole or (in the case of dwellings) by qualified assumption (i.e. the annual mean external temperature at the location).

The water source shall enable a continuous extraction of the design flow rate of the attached heat pumps. The possible extraction flow rate is dependant on local geological factors and can be ascertained by continuously

extracting the nominal flow rate in a test run of sufficient duration to attain quasi-steady-state conditions. For larger systems, hydrogeological investigations (e.g. well test) may be necessary.

The water should be free of impurities and aggressive substances so as to prevent clogging of the injection well. Care should be taken not to allow oxygen to enter the system, in particular in case iron and manganese are present in the water. The manufacturer's specifications shall be adhered to. If no manufacturer's specifications are available, guidance values for the water quality are given in Annex A.

If the above requirements cannot be achieved (e.g. in case of sea-water), a secondary circuit or a water treatment shall be considered.

The water shall be returned to the environment as clean as possible and in accordance with local regulations.

Provisions for returning the water shall be provided for. The direction of the ground water flow shall be taken into account when selecting the position of the injection well. The extraction well shall be situated upstream of the injection well if the heat pump is only used for heating purposes (see Figure 1).

The heat extraction system shall be designed and controlled so as to avoid the risk of freezing.