SLOVENSKI STANDARD
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Grelni sistemi v stavbah - Metoda za preraļ un energijskih zahtev in uļ inkovitosti sistema - 4-3. del: Sistemi za ogrevanje prostora, toplotni sonļ ni sistemi

Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-3: Heat generation systems, thermal solar systems

Heizsysteme in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 4-3: Wärmeerzeugungssysteme, thermische Solaranlagen

Systemes de chauffage dans les bâtiments - Méthode de calcul des besoins énergétiques et d'efficacité des systemes - Partie 2-2-3 : Systemes de génération de chauffage des locaux - Systemes solaires thermiques

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Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-3: Heat generation systems, thermal solar systems

Systèmes de chauffage dans les bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 4-3 : Systèmes de génération de chaleur, systèmes solaires thermiques

Heizsysteme in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Wirkungsgrade von Systemen - Teil 4-3: Wärmeerzeugungssysteme Thermische Solaranlagen

This European Standard was approved by CEN on 30 June 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 15316-4-3:2007) 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of an identical text or by endorsement, at the latest by January 2008, and conflicting national standards shall be withdrawn at the latest by January 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343), and supports essential requirements of EU Directive 2002/91/EC on the energy performance of buildings (EPBD). It forms part of a series of standards aimed at European harmonisation of the methodology for calculation of the energy performance of buildings. An overview of the whole set of standards is given in prCEN/TR 15615.

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.

EN 15316 *Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies* consists of the following parts:

Part 1: General

Part 2-1: Space heating emission systems

Part 2-3: Space heating distribution systems

Part 3-1: Domestic hot water systems, characterisation of needs (tapping requirements)

Part 3-2: Domestic hot water systems, distribution

Part 3-3: Domestic hot water systems, generation

Part 4-1: Space heating generation systems, combustion systems (boilers)

Part 4-2: Space heating generation systems, heat pump systems

Part 4-3: Heat generation systems, thermal solar systems

Part 4-4: Heat generation systems, building-integrated cogeneration systems

Part 4-5: Space heating generation systems, the performance and quality of district heating and large volume systems

Part 4-6: Heat generation systems, photovoltaic systems

Part 4-7: Space heating generation systems, biomass combustion systems

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 European Standard presents methods for calculation of the thermal solar system input for space heating and/or domestic hot water requirements and the thermal losses and auxiliary energy consumption of the thermal solar system. The calculation is based on the performance characteristics of the products given in product standards and on other characteristics required to evaluate the performance of the products as included in the system.

This method can be used for the following applications:

— judging compliance with regulations expressed in terms of energy targets;

— optimisation of the energy performance of a planned heat generation system, by applying the method to several possible options;

— assessing the effect of possible energy conservation measures on an existing heat generation system, by calculating the energy use with and without the energy conservation measure – i.e. the energy savings of a thermal solar system is determined by the difference in the calculated energy performance of the building with and without the thermal solar system.

The user needs to refer to other European Standards or to national documents for input data and detailed calculation procedures not provided by this European Standard.

1 Scope

This European Standard is part of a series of standards on the method for calculation of system energy requirements and system efficiencies. The framework for the calculation is described in prEN 15603.

The scope of this specific part is to standardise the:

— required inputs,

— calculation method,

— required outputs,

for thermal solar systems (including control) for space heating, domestic hot water production and the combination of both.

The following typical thermal solar systems are considered:

— domestic hot water systems characterized by EN 12976 (factory made) or ENV 12977 (custom built);

— combisystems (for domestic hot water and space heating) characterized by ENV 12977 or the Direct Characterisation method developed in Task 26 'Solar Combisystems' of the IEA Solar Heating and Cooling programme;

— space heating systems characterized by ENV 12977.

2 Normative references

The following referenced documents are indispensable for the application 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 12976-2, *Thermal solar systems and components — Factory made systems — Part 2: Test methods*

EN ISO 7345:1995, *Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

3 Terms and definitions

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

3.1
aperture area
solar collector maximum projected area through which un-concentrated solar radiation enters the collector

3.2
auxiliary energy
electrical energy used by technical building systems for heating, cooling, ventilation and/or domestic hot water to support energy transformation to satisfy energy needs

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

NOTE 2 In EN ISO 9488, the energy used for pumps and valves is called "parasitic energy".

3.3
back-up energy
source of heat, other than solar, used to supplement the output provided by the thermal solar system

NOTE In EN ISO 9488, the back-up energy is called auxiliary energy.

3.4
collector loop
circuit, including collectors, pump or fan, pipework and heat exchanger (if present), which is used to transfer heat from the collectors to the heat storage device

3.5
forced-circulation system
system which utilizes a pump or a fan to circulate the heat transfer fluid through the collector(s)

3.6
heat use for space heating and/or domestic hot water
heat input to the space heating system and/or the domestic hot water system to satisfy the energy needs for space heating and/or domestic hot water, respectively

NOTE 1 If the technical building system serves several purposes (e.g. space heating and domestic hot water) it can be difficult to split the energy use into that used for each purpose. It can be indicated as a combined quantity (e.g. energy use for space heating and domestic hot water).

NOTE 2 The heat use for space heating and/or domestic hot water is the sum of the energy needs and the system thermal losses of the space heating system and/or the domestic hot water system minus the recovered system thermal losses at the system boundary.

3.7
recoverable system thermal loss

part of the system thermal loss which can be recovered to lower either the energy need for heating or cooling or the energy use of the heating or cooling system

3.8
recovered system thermal loss
part of the recoverable system thermal loss which has been recovered to lower either the energy need for heating or cooling or the energy use of the heating or cooling system

3.9
solar collector
device designed to absorb solar radiation and to transfer the thermal energy so produced to a fluid passing through

3.10
solar combisystem
thermal solar system delivering energy to both domestic hot water and space heating

3.11
solar domestic hot water (DHW) system
thermal solar system delivering energy to domestic hot water

3.12
solar fraction
energy supplied by the solar part of a system divided by the total system heat use (without the generation system losses)

3.13
solar preheat system
thermal solar system to preheat water prior to its entry into any other type of water heater

3.14
solar space heating (SH) system
thermal solar system delivering energy to space heating

3.15
solar-only system
thermal solar system without any back-up heat source

NOTE In EN ISO 9488, the back-up energy is called "auxiliary energy".

3.16
solar-plus-supplementary system
thermal solar system which utilizes both solar and auxiliary energy sources in an integrated way and is able to provide a specified heating service independent of solar energy availability

3.17
system thermal loss
thermal loss from a technical building system for heating, cooling, domestic hot water, humidification, dehumidification, or ventilation or lighting that does not contribute to the useful output of the system

NOTE A system thermal loss can become an internal heat gain for the building if it is recoverable.

3.18
technical building sub-system

part of a technical building system that performs a specific function (e.g. heat generation, heat distribution, heat emission)

3.19
technical building system
technical equipment for heating, cooling, ventilation, domestic hot water, lighting and electricity production composed by sub-systems

NOTE A technical building system can refer to one or to several building services (e.g. heating system, heating and domestic hot water system).

3.20
thermal solar system
system composed of solar collectors and other components for the delivery of thermal energy

3.21
thermosiphon system
system which utilizes only density changes of the heat transfer fluid to achieve circulation between collector and storage device or collector and heat exchanger

3.22
zero-loss collector efficiency
efficiency of the collector, when the collector mean fluid temperature is equal to the ambient temperature

NOTE When using data from EN 12975 and EN 12976 test reports for the calculations described in this European Standard, one needs to be careful to use the right values, as these test reports use the definitions according to ISO.

4 Symbols and abbreviations

For the purposes of this document, the following symbols and units (Table 1) and indices (Table 2) apply.

Table 1 — Symbols and units

A	collector aperture area	m²
A_C*	effective collector loop area	m²
a_1	heat loss coefficient of solar collector	W/(m²·K)
a_2	temperature dependence of the heat loss coefficient	W/(m²·K²)
a, b, c,d,e,f	correlation factors	-
C_S	heat capacity of the storage tank	MJ/K
E	solar irradiation in a tilted plane	kWh/m²
f_{aux}	fraction of the storage tank volume used for back-up heating	-
f_{sol}	solar fraction	%
f_{st}	storage tank capacity correction factor	-
I	solar irradiance on the collector plane	W/m²
IAM	collector incidence angle modifier	-
P	power	W
Q	quantity of heat	kWh
S	savings	
t	time, period of time	hours
U	heat loss coefficient	W/(m²·K)
U_C*	effective collector heat loss coefficient (related to effective collector aperture area)	W/(m²·K)
V	volume	litres
W	auxiliary (electrical) energy	kWh
x, y	dimensionless factors	-
ΔT	reference temperature difference	K
θ_a	average ambient air temperature over the considered period	°C
θ_{cw}	mains water temperature	°C
θ_e	outside air temperature over the considered period	°C
η	efficiency factor	-

Table 2 — Indices

0	base reference	nom	nominal
a	air	nrbl	non recoverable
an	annual	nrvd	non recovered
aux	auxiliary	out	output from system
avg	average	p	pump
bu	back up	par	performance indicator (Qpar)
cw	cold water	rbl	recoverable
d	performance indicator (Qd)	ref	reference
dis	distribution	rvd	recovered
e	external	set point	set point
H	space heating	sol	solar
in	input to system	St	storage
int	internal	Tot	total
loop	collector loop	us	use
ls	losses	W	domestic hot water
m	monthly		

5 Principle of the method

5.1 Building heat requirements influence the energy performance of a thermal solar system

The performance of a thermal solar system depends on the thermal use applied to the system. The thermal use applied to the thermal solar system is the heat requirements of the building, including the energy needs, the thermal losses from the emission systems (emitters) and the thermal losses from the distribution systems (pumps and pipes). In general, the higher the total thermal use applied to the thermal solar system is, the higher is the output of the thermal solar system. Therefore, before starting determination of the system output, it is necessary to know the energy use applied to the thermal solar system:

Energy use applied for the space heating system:

— required space heating needs (see EN ISO 13790);

— thermal losses from space heating emission (see EN 15316-2-1);

— thermal losses from space heating distribution (see EN 15316-2-3).

Energy use applied for the domestic hot water system:

— required energy for domestic hot water needs, including emission losses (see prEN 15316-3-1);

— thermal losses from domestic hot water distribution (see prEN 15316-3-2).