SLOVENSKI STANDARD

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Grelni sistemi v stavbah - Metoda za preraļ un energijskih zahtev in uļ inkovitosti sistema - 4-6. del: Sistemi za gretje prostora, fotonapetostni sistemi

Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-6: Heat generation systems, photovoltaic systems

Heizsysteme in Gebäuden - Berechnung und Bewertung der Energieeffizienz von Systemen - Teil 4-6: Wärmeerzeugungssysteme, photovoltaische Systeme

Systemes de chauffage dans les bâtiments - Méthode de calcul des besoins énergétiques et d'efficacité des systemes - Partie 4-6: Systemes de génération de chauffage des locaux, performance de la chaleur et de l'électricité d'autres énergies

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Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-6: Heat generation systems, photovoltaic systems

Systèmes de chauffage dans les bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 4-6: Systèmes de génération de chaleur, systèmes photovoltaïques

Heizsysteme in Gebäuden - Verfahren zur Berechnung des Energiebedarfs und Nutzungsgrade der Anlagen - Teil 4-6: Wärmeerzeugungssysteme, photovoltaische Systeme

This European Standard was approved by CEN on 24 June 2007.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

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 15316-4-6:2007) 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 constitutes the specific part related to building integrated photovoltaic systems, of the set of EN 15316 standards on methods for calculation of system energy requirements and system efficiencies of space heating systems and domestic hot water systems in buildings.

This European Standard presents a method for calculation of the electricity production of building integrated photovoltaic systems.

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.

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.

Only the calculation method and the accompanying input parameters are normative. All values required to parameter the calculation method should be given in a national annex, containing appropriate national values corresponding to the tables given in Annex B.

1 Scope

This European Standard is part of a set of standards on the method for calculation of system energy requirements and system efficiencies.

The scope of this specific part is to standardise for photovoltaic systems:

— required inputs;

— calculation method;

— resulting outputs.

The calculation method applies only to building integrated photovoltaic systems.

The calculation method does not take into account:

— electrical storage;

— PV/thermal photovoltaic systems.

The calculation method describes how to calculate the electricity production of photovoltaic systems.

Primary energy savings and CO_2 savings, which can be achieved by photovoltaic systems compared to other systems, are calculated according to prEN 15603.

Standards linked to photovoltaic systems are listed in Annex A.

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 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
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 a 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".

3.2
building integrated photovoltaic systems
system where the building envelope (roof, walls etc.) is used to support the photovoltaic panels

3.3
net power production
total power produced by the photovoltaic panel minus all auxiliary energy consumption inside the sub-system boundaries

3.4
peak power
electrical power of a photovoltaic system with a given surface and for a solar irradiance of 1 kW/m2 on this surface (at 25 °C)

3.5
recoverable system thermal loss
part of a 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

3.6
recovered loss
part of the recoverable losses which are recovered to lower the energy requirements

3.7
renewable energy produced on the building site
energy produced by technical building systems directly connected to the building using renewable energy sources

3.8
renewable energy

energy from a source that is not depleted by extraction, such as solar energy (thermal and photovoltaic), wind, water power, renewed biomass

NOTE In ISO 13602-1, renewable resource is defined as "natural resource for which the ratio of the creation of the natural resource to the output of that resource from nature to the technosphere is equal to or greater than one".

3.9
solar irradiance
power density of radiant incident on a surface, i.e. the quotient of the radiant flux incident on the surface and the area of that surface, or the rate at which radiant energy is incident on a surface, per unit area of that surface. Irradiance is normally expressed in Watts per square meter (W/m^2)

[ISO 9488:1999]

NOTE The reference solar irradiance is equal to 1 kW/m^2.

3.10
solar irradiation
incident energy per unit area of surface, found by integration of irradiance over a specified time interval, often an hour or a day. Irradiation is normally expressed in megajoules per square metre (MJ/m^2)

[ISO 9488:1999]

3.11
system thermal loss
thermal loss from a technical building system for heating, cooling, domestic hot water, humidification, dehumidification, ventilation or lighting that does not contribute to the useful output of the system

NOTE Thermal energy recovered directly in the subsystem is not considered as a system thermal loss but as heat recovery and directly treated in the related system standard.

3.12
technical building sub-system
part of a technical building system that performs a specific function (e.g. heat generation, heat distribution, heat emission, electricity production)

3.13
technical building system
technical equipment for heating, cooling, ventilation, domestic hot water, lighting and electricity production composed by sub-systems

NOTE 1 A technical building system can refer to one or to several building services (e.g. heating system, heating and DHW system).

NOTE 2 Electricity production can include cogeneration and photovoltaic systems.

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

Symbol	Quantity	Unit
A	area, total surface of all photovoltaic modules (without frame)	m^2
E	annual solar irradiation	Wh/m^2 [a]
	energy in general, including primary energy, energy carriers (except quantity of heat, mechanical work and auxiliary (electrical) energy)	Wh [a] [b]
f	factor [c]	-
I	solar irradiance	W/m^2
K	coefficient	[c]
P	power in general including electrical power	W
Q	quantity of heat	Wh [a]
T	thermodynamic temperature	K
W	auxiliary (electrical) energy, mechanical work	Wh [a]
θ	Celsius temperature	°C

[a] Seconds (s) may be used as the unit for time instead of hours (h) for all quantities involving time (i.e. for time periods as well as for air change rates), but in that case the unit for energy is J instead of Wh.
[b] The unit depends on the type of energy carrier and the way its amount is expressed.
[c] Coefficients have dimensions; factors are dimensionless.

Table 2 — Indices

an	annual	ls	losses	rbl	recoverable
aux	auxiliary	out	output	ref	reference
el	electricity	perf	performance	sol	solar
gen	generation	pk	peak	T	thermal
hor	horizontal	pv	solar electricity (photovoltaic)	tlt	tilt and orientation
in	input				

5 Calculation method

5.1 Energy delivered by the photovoltaic system

Electricity produced by the photovoltaic system $E_{el,pv,out}$ is calculated by:

$$E_{el,pv,out} = \frac{E_{sol} \bullet P_{pk} \bullet f_{perf}}{I_{ref}} \quad \text{[kWh/year]} \qquad (1)$$

where

E_{sol} is the annual solar irradiation on the photovoltaic system [(kWh/m^2)/year];

P_{pk} is the peak power [kW], represents the electrical power of a photovoltaic system with a given surface and for a solar irradiance of 1 kW/m^2 on this surface (at 25 °C);

f_{perf} is the system performance factor [-];

I_{ref} is the reference solar irradiance equal to 1 kW/m^2.

NOTE 1 This value of $E_{el,pv,out}$ is input data for calculations according to prEN 15603.

Calculation examples are given in Annex C. Take into account also the influence of shadowing effects from various parts of the building (e.g. chimneys, ventilation units) on the annual quantity of electricity produced.

For renewable energy produced on the building site, no energy input is taken into account.

$E_{pv,gen,in} = 0$

NOTE 2 This value is input data for calculations according to prEN 15603.

NOTE 3 prEN 15603 specifies that for active solar systems, the incident solar radiation on the solar panels is not part of the energy balance. Only the energy delivered by the generation device is taken into account in the energy balance.

5.2 Solar irradiation on the photovoltaic modules

The solar irradiation E_{sol} on the photovoltaic modules is calculated by:

$$E_{sol} = E_{sol,hor} \bullet f_{tlt} \quad \text{[(kWh/m}^2\text{)/year]} \qquad (2)$$

where