SLOVENSKI STANDARD
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Ogrevalni sistemi v stavbah - Metoda za preraļ un energijskih zahtev in uļ inkovitosti sistema - 4-1. del: Sistemi za ogrevanje prostora, zgorevalni sistemi

Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating generation systems, boilers

Heizanlagen in Gebäuden - Berechnung und Bewertung der Energieeffizienz von Systemen - Teil 4-1: Wärmeerzeugung für die Raumheizung, Verbrennungssysteme

Systemes de chauffage dans les bâtiments - Méthode de calcul des besoins énergétiques et d'efficacité des systemes - Partie 2-2-1 : Systemes de génération de chauffage des locaux, Chaudieres

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ICS:

91.140.10	Sistemi centralnega ogrevanja	Central heating systems

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Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating generation systems, combustion systems (boilers)

Systèmes de chauffage dans les bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 4-1 : Systèmes de génération de chauffage des locaux, systèmes de combustion (chaudières)

Heizanlagen in Gebäuden - Berechnung und Bewertung der Energieeffizienz von Systemen - Teil 4-1: Wärmeerzeugung für die Raumheizung, Verbrennungssysteme

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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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Contents

Page

Foreword

This document (EN 15316-4-1:2008) 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of an identical text or by endorsement, at the latest by November 2008, and conflicting national standards shall be withdrawn at the latest by November 2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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 CEN/TR 15615, ‘Explanation of the general relationship between various CEN standards and the Energy Performance of Buildings Directive (EPBD)’ ("Umbrella document").'

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 the United Kingdom.

Introduction

This European Standard presents methods for calculation of the additional energy requirements of a heat generation system in order to meet the distribution and/or storage sub-system demand. 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.

The user shall 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 of space heating systems and domestic hot water systems.

The scope of this specific part is to standardise the:

— required inputs;

— calculation method;

— resulting outputs;

for space heating generation by combustion sub-systems (boilers), including control.

This European Standard is the general standard on generation by combustion sub-systems (boilers). If a combustion generation sub-system is within the scope of another specific part of the EN 15316 series (i.e. part 4.x), the latter shall be used.

EXAMPLE Biomass combustion generation sub-systems are within the scope of prEN 15316-4-7.

This European Standard is also intended for the case of generation for both domestic hot water production and space heating. The case of generation only for domestic hot water production is treated in EN 15316-3-3.

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 297, *Gas-fired central heating boilers - Type B_{11} and B_{11Bs} boilers fitted with atmospheric burners of nominal heat input not exceeding 70 kW*

EN 303-5, *Heating boilers – Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking*

EN 304, *Heating boilers — Test code for heating boilers for atomizing oil burners*

EN 656, Gas-fired central heating boilers — *Type B boilers of nominal heat input exceeding 70 kW but not exceeding 300 kW*

EN 15034:2006, *Heating boilers - Condensing heating boilers for fuel oil*

EN 15035, *Heating boilers - Special requirements for oil fired room sealed units up to 70 kW*

EN 15316-2-1, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.1: Space heating emission systems*

EN 15316-2-3:2007, *Heating systems in building - Method for calculation of system energy requirements and system efficiencies – Part 2.3: Space heating distribution systems*

EN 15316-3-2, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 3.2: Domestic hot water systems, distribution*

EN 15456, *Heating boilers – Electrical power consumption for heat generators – System boundaries – Measurements*

EN 15603, *Energy performance of buildings — Overall energy use and definition of energy ratings*

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

EN ISO 13790, *Thermal performance of buildings - Calculation of energy use for space heating (ISO 13790:2004)*

3 Terms and definitions

3.1 Definitions

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

3.1.1
space heating
process of heat supply for thermal comfort

3.1.2
domestic hot water heating

process of heat supply to raise the temperature of the cold water to the intended delivery temperature

3.1.3
heated space
room or enclosure which for the purposes of the calculation is assumed to be heated to a given set-point temperature or set-point temperatures

3.1.4
system thermal loss
thermal loss from a technical building system for heating, cooling, domestic hot water, humidification, dehumidification, ventilation or lighting or other appliances that does not contribute to the useful output of the system

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

3.1.5
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.

NOTE 2 In EN ISO 9488 [4], the energy used for pumps and valves is called "parasitic energy".

3.1.6
heat recovery
heat generated by a technical building system or linked to a building use (e.g. domestic hot water) which is utilised directly in the related system to lower the heat input and which would otherwise be wasted (e.g. preheating of the combustion air by flue gas heat exchanger)

3.1.7
total system thermal loss
total of the technical system thermal loss, including recoverable system thermal losses

3.1.8
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

3.1.9
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 required energy use of the heating or cooling system

3.1.10
gross calorific value
quantity of heat released by a unit quantity of fuel, when it is burned completely with oxygen at a constant pressure equal to 101 320 Pa, and when the products of combustion are returned to ambient temperature

NOTE 1 This quantity includes the latent heat of condensation of any water vapour contained in the fuel and of the water vapour formed by the combustion of any hydrogen contained in the fuel.

NOTE 2 According to ISO 13602-2 [5], the gross calorific value is preferred to the net calorific value.

NOTE 3 The net calorific value does not take into account the latent heat of condensation.

3.1.11
net calorific value
gross calorific value minus latent heat of condensation of the water vapour in the products of combustion at ambient temperature

3.1.12
calculation step
discrete time interval for the calculation of the energy needs and uses

NOTE Typical discrete time intervals are one hour, one month or one heating and/or cooling season, operating modes, and bins.

3.1.13
calculation period
period of time over which the calculation is performed

NOTE The calculation period can be divided into a number of calculation steps.

3.1.14
external temperature
temperature of external air

NOTE 1 For transmission heat transfer calculations, the radiant temperature of the external environment is supposedly equal to the external air temperature; long-wave transmission to the sky is calculated separately.

NOTE 2 The measurement of external air temperature is defined in EN ISO 15927-1, Hygrothermal performance of buildings - Calculation and presentation of climatic data — Part 1: Monthly means of single meteorological elements.

3.1.15
heat transfer coefficient
factor of proportionality of heat flow governed by a temperature difference between two environments

3.1.16
boiler
gas, liquid or solid fuelled appliance designed to provide hot water for space heating. It may (but need not) be designed to provide domestic hot water heating as well

3.1.17
combustion power
product of the fuel flow rate and the net calorific power of the fuel

3.1.18
low temperature boiler
non-condensing boiler designed as a low temperature boiler and tested as a low temperature boiler as prescribed by the Council Directive 92/42/EEC about Boiler Efficiency [1]

3.1.19
condensing boiler
boiler designed to make use of the latent heat released by condensation of water vapour in the combustion flue products. The boiler must allow the condensate to leave the heat exchanger in liquid form by way of a condensate drain

NOTE Boilers not so designed, or without the means to remove the condensate in liquid form, are called 'non-condensing'.

3.1.20
oil condensing boiler
boiler designed to make use of the latent heat released by condensation of water vapour in the combustion flue products of a liquid fuel

[EN 15034:2006]

3.1.21
modes of operation
various modes in which the heating system can operate

EXAMPLES Set-point mode, cut-off mode, reduced mode, set-back mode, boost mode.

3.1.22
on/off boiler
boiler without the capability to vary the fuel burning rate whilst maintaining continuous burner firing. This includes boilers with alternative burning rates set once only at the time of installation, referred to as range rating

3.1.23
multistage boiler
boiler with the capability to vary the fuel burning rate stepwise whilst maintaining continuous burner firing

3.1.24
modulating boiler
boiler with the capability to vary continuously (from a set minimum to a set maximum) the fuel burning rate whilst maintaining continuous burner firing

3.2 Symbols and units

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

Table 1 – Symbols and units

Symbol	Name of quantity	Unit
b	temperature reduction factor	-
c	coefficient	various
c	specific heat capacity	J/kg·K or Wh/kg·K [a)]
d	thickness	mm
E	energy in general (except quantity of heat, mechanical work and auxiliary (electrical) energy)	J or Wh [a)]
e	expenditure factor	-
f	factor	-
H	calorific value	J/mass unit or Wh/mass unit [b)]
H	heat transfer coefficient	W/K
k	factor	-
m	mass	kg
n	exponent	-
N	number of items	Integer
P	power in general including electrical power	W
Q	quantity of heat	J or Wh [a)]
t	time, period of time	s or h [a)]
V	volume	L
V'	volume flow	m^3/s or m^3/h [a)]
W	auxiliary (electrical) energy, mechanical work	J or Wh [a)]
x	relative humidity	%
X	volume fraction	%
α	loss factor	%
β	load factor	-
Δ	prefix for difference	
η	efficiency factor	%

Table 1 – Symbols and units

Symbol	Name of quantity	Unit
θ	Celsius temperature	°C
ρ	density	kg/m³
Φ	heat flow rate, thermal power	W
a)	If seconds (s) is used as the unit of time, the unit for energy shall be J. If hours (h) is used as the unit of time, the unit for energy shall be Wh.	
b)	Mass unit for fuel may be Stm³, Nm³ or kg.	

Table 2 – Indices

add	additional	gnr	generator	plt	pilot
air	air	grs	gross	pmp	after the combustion chamber
aux	auxiliary	H	heating	Pn	at nominal load
avg	average	i, j, k	indices	Px	at x load
br	before generator	in	input to sub-system	r	return
brm	boiler room	ins	insulation	rbl	recoverable
ch	chimney	lat	latent	ref	reference
ci	calculation step	ls	losses	rvd	recovered
cmb	combustion	m	mean	s	gross (calorific value)
cond	condensing	max	maximum	sat	saturation
corr	corrected / correction	mass	massic	sby	in stand-by operation
ctr	control	min	minimum	st	stoichiometric
dis	distribution	n	nominal	sto	storage
dry	dry gases	net	net	test	test conditions
em	emission	O2	oxygen	th	thermal
emr	emitter	off	off	W	heating system water
f	flow (temperature)	on	on	w	water
fg	flue gas	out	output from sub-system	wfg	water to flue gas
ge	generator envelope	P0	at zero load	z	indices
gen	generation sub-system	Pint	at intermediate load		