SLOVENSKI PREDSTANDARD

oSIST prEN 15315:2005

september 2005

Heating systems in buildings - Energy performance of buildings - Overall energy use, primary energy and CO2 emissions

ICS 91.140.10

Referenčna številka
oSIST prEN 15315:2005(en)

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 15315

July 2005

ICS

English version

Heating systems in buildings - Energy performance of buildings - Overall energy use, primary energy and CO2 emissions

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. prEN 15315:2005: E

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Foreword

This document (prEN 15315:2005) has been prepared by Technical Committee CEN/TC 228 “Heating systems in buildings”, the secretariat of which is held by DS.

This document is currently submitted to the CEN Enquiry.

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.

Introduction

This standard specifies a general framework for the assessment of overall energy use of a building and calculation of overall energy performance in terms of primary energy and CO_2 emissions. Separate standards specify calculation of the energy consumption of services within a building (i.e. heating, cooling, ventilation, domestic hot water, lighting). In the present standard, these energy consumptions are considered for calculation of the overall energy use.

Allowance is made for energy that may be generated within, or on the surface of, the building, and which is used to offset fuel and power drawn from other sources. Electrical energy generated in excess of the instantaneous demand is considered, provided it is exported to the public supply for use elsewhere.

A comprehensive approach is needed for appropriate evaluation of all options to improve the energy performance of buildings. The assessment is not limited to the building alone, but takes into account the wider environmental impact of the energy supply chain. From an assessment of overall energy use, building owners and policy-makers can gain an understanding of the relative merits of alternative options.

The user shall refer to other European Standards or to national documents for input data and detailed calculation procedures not provided by this standard. Local values for factors needed to calculate the primary energy consumption and CO_2 emissions should be defined in a national annex.

1 Scope

The purpose of this standard is to:

— collate results from other standards that specify calculation of energy consumption within a building;

— account for energy generated in the building, some of which may be exported for use elsewhere;

— present a summary on tabular form of the overall energy use of the building;

— specify calculation of primary energy consumption and carbon dioxide emission for the building as a whole;

— establish general principles for the calculation of primary energy factors and carbon dioxide emission factors.

This standard will provide:

— a definition of system boundaries (e.g. building, installations, energy supply) and calculation periods;

— general definition of the overall energy use (i.e. determine which services are taken into account within the system boundaries);

— definition of energy terms (energy use, primary energy, etc.);

— definition of the data interfaces with other standards in order to report the overall energy use of buildings;

— general procedures for taking into consideration decentralised energy production based on renewable energy and CHP (combined heat and power production), e.g. to show how on-site energy generation offsets energy demand;

— identification of the energy streams across system boundaries;

— principles for assessing primary energy consumption and CO_2 emission of buildings (i.e. principles for determining primary energy factors and carbon dioxide emission factors);

— general principles for taking into account the interactions between the different energy uses (e.g. calculation of recovered losses and gains).

The objective of specifying the details of the energy performance calculation for a building is to:

— underline the particularity of a project (e.g. efforts made on bioclimatic design);

— show the strong and the weak points in the overall energy performance of the building and to highlight potential gains:

— distinguish between thermal uses and specific electrical uses;

— indicate the outputs required from related standards, in which calculation of energy consumption of services within a building are specified.

This work will be coordinated with CEN/TC TC 89, TC 156, TC 169, and TC 247.

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, *Thermal insulation - Physical quantities and definitions*

prEN wi 7, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 1: General*

prEN wi 8, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.1: Space heating emission systems*

prEN wi 9 part 2.2.1, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.1: Space heating generation systems, Combustion systems*

prEN wi 9 part 2.2.2, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.2: Space heating generation systems, Heat pump systems*

prEN wi 9 part 2.2.3, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.3: Space heating generation systems, Thermal solar systems*

prEN wi 9 part 2.2.4, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.4: Space heating generation systems, The performance and quality of CHP electricity and heat (incl. on-site and micro-CHP)*

prEN wi 9 part 2.2.5, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.5: Space heating generation systems, The performance and quality of district heating and large volume systems*

prEN wi 9 part 2.2.6, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.6: Space heating generation systems, The performance of other renewables heat and electricity*

prEN wi 9 part 2.2.7, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.2.7: Space heating generation systems, Biomass combustion systems*

prEN wi 10, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.3: Space heating distribution systems*

prEN wi 11 part 3.1, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 3.1: Domestic hot water systems, characterisation of needs (tapping requirements)*

prEN wi 13, *Energy performance of buildings – Energy requirements for lighting*

prEN wi 14, *Energy performance of buildings – Calculation of energy use for space heating and cooling – Simplified method*

prEN wi 17, *Thermal performance of buildings – Calculation of energy use for space heating and cooling – General criteria and validation procedures*

prEN wi 20, *Ventilation for buildings – Calculation methods for energy requirements due to ventilation systems in buildings*

3 Definitions and symbols

3.1 Definitions

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

3.1.1

building net energy (useful energy)
energy supplied by ideal energy systems (no system losses are taken into account) to provide the required services for heating, cooling, ventilation, domestic hot water and lighting. Recovered losses and gains are taken into account

3.1.2

building system
technical equipments for heating, cooling, ventilation, domestic hot water and lighting

3.1.3

CO_2 emission factor
quantity of CO_2 emitted to the atmosphere per unit of energy source (kg CO_2 / kWh energy source)

3.1.4

CO_2 annual emission factor (system-average for an entire year)
emission factor calculated by estimating the total CO_2 emissions during a year and dividing that figure by the total energy delivered over the year

3.1.5

CO_2 marginal emission factor (average for an entire year)
emission factor applied to multi-plant generation systems and depending on the plant merit order (priority order in which the plants are put into operation as demand changes), the size of the system and the demand pattern

3.1.6

calculation period
time period (time step) considered for calculation of the energy losses and gains (e.g. month, day, boosted subperiod), ref. prEN wi 7

3.1.7

co-generation (building bound)
combined generation of power (electricity) and heat, where heat delivery is restricted to the buildings. The total amount of heat to be delivered by the building bound co-generation unit can be determined unequivocal. Other cases of co-generation will be considered as district heating

3.1.8

cooling
process of heat extraction for thermal comfort

3.1.9

delivered energy
energy supplied to the building through the system boundary to satisfy the energy requirements for heating, cooling, ventilation, domestic hot water and lighting

3.1.10

energy carrier
substance or phenomenon that can be used either to produce mechanical work or heat or to operate chemical or physical processes

3.1.11

energy demand
energy to be delivered by an ideal energy system (no system losses are taken into account) to provide the required service to the end user (e.g. to maintain the internal set-point temperature of a heated space)

3.1.12

energy requirements
energy supplied to the technical system (system losses are taken into account) to provide the required service. Energy requirements can be specified for each subsystem (e.g. distribution, storage) and express the energy supplied to the subsystem

3.1.13

energy supplied
energy made available. Energy can be supplied at different levels (e.g. termed “net energy” or “useful energy” when made available to the consumer after final conversion to provide the required service)

3.1.14

net energy
energy supplied by the energy systems to provide the required services, e.g. maintaining the building at the specified internal temperature, ventilating a space, lighting a space. Recovered losses and gains are taken into account

3.1.15

overall energy use of the building
energy delivered to the energy systems for heating, cooling, ventilation, domestic hot water and lighting. The overall energy takes into account the delivered energy and the energy produced inside the building and delivered back to the market

3.1.16

primary energy
energy that has not been subject to any conversion or transformation process (e.g. oil in the oil fields). Primary energy may be either resource energy or renewable energy or a combination of both

3.1.17

primary energy factor
primary energy divided by delivered energy, where primary energy is the energy required to supply one unit of delivered energy of the same type, taking into account the primary energy required for extraction, processing, storage, transport, generation, transformation, transmission, distribution, and any other operations necessary for delivery of energy to the building in which the delivered energy will be used. Delivery operations may call for energy of various types (e.g., electricity, oil), and each of those should be given as primary energy using the appropriate primary energy factor

3.1.18

primary resource energy factor
resource energy divided by delivered energy, where resource energy is the energy required to supply one unit of delivered energy, taking into account the resource energy required for extraction, processing, storage, transport, generation, transformation, transmission, distribution, and any other operations necessary for delivery of energy to the building in which the delivered energy will be used. Any renewable energy component of the delivered energy is ignored. Delivery operations may call for energy of various types (e.g.

electricity, oil), and each of those should be given as resource energy using the appropriate primary resource energy factor.

3.1.19

recoverable losses
part of the losses from the heating, cooling, ventilation, domestic hot water and lighting systems, which may be recovered to lower the energy requirements

3.1.20

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

3.1.21

renewable energy
energy taken from a source which is not depleted by extraction (e.g. solar, wind)

3.1.22

resource energy
energy taken from a source which is depleted by extraction (e.g. fossil fuels)

3.1.23

system
technical equipment providing a required service (e.g. heating system providing the required service for heating)

3.1.24

utilisation factor
fraction of recoverable losses or gains that can be recovered.

3.1.25

ventilation heat loss
heat loss resulting from heating of the average amount of air per time unit that enters a building or part of a building in one way or another

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
E	emission	kg
f	conversion factor	-
Q	quantity of heat, energy	kWh