SLOVENSKI STANDARD
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Merila notranjega okolja za načrtovanje in ocenjevanje toplotnih lastnosti stavb z upoštevanjem notranje kakovosti zraka, toplotnega okolja, svetlobe in hrupa

Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics

Eingangsparameter für das Raumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden - Raumluftqualität, Temperatur, Licht und Akustik

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Criteres pour l'environnement intérieur et évaluation des performances énergétiques des bâtiments couvrant la qualité d'air intérieur, la thermique, l'éclairage et l'acoustique

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2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD
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EN 15251

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Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics

Critères pour l'environnement intérieur et évaluation des performances énergétiques des bâtiments couvrant la qualité d'air intérieur, la thermique, l'éclairage et l'acoustique

Eingangsparameter für das Raumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden - Raumluftqualität, Temperatur, Licht und Akustik

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

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Foreword

This document (EN 15251:2007) has been prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by November 2007, and conflicting national standards shall be withdrawn at the latest by November 2007.

This standard 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 the 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").

Attention is drawn to the need for observance of relevant EU Directives transposed into national legal requirements. Existing national regulations with or without reference to national standards, may restrict for the time being the implementation of the European Standards mentioned in this report.

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Introduction

Energy consumption of buildings depends significantly on the criteria used for the indoor environment (temperature, ventilation and lighting) and building (including systems) design and operation. Indoor environment also affects health, productivity and comfort of the occupants. Recent studies have shown that costs of poor indoor environment for the employer, the building owner and for society, as a whole are often considerable higher than the cost of the energy used in the same building. It has also been shown that good indoor environmental quality can improve overall work and learning performance and reduce absenteeism. In addition uncomfortable occupants are likely to take actions to make themselves comfortable which may have energy implications. An energy declaration without a declaration related to the indoor environment makes no sense. There is therefore a need for specifying criteria for the indoor environment for design, energy calculations, performance and operation of buildings

There exist national and international standards, and technical reports, which specify criteria for thermal comfort and indoor air quality (EN ISO 7730, CR 1752). These documents do specify different types and categories of criteria, which may have a significant influence on the energy demand. For the thermal environment criteria for the heating season (cold/winter) and cooling season (warm/summer) are listed. These criteria are, however, mainly for dimensioning of building, heating, cooling and ventilation systems. They may not be used directly for energy calculations and year-round evaluation of the indoor thermal environment. New results have shown that occupant expectations in natural ventilated buildings may differ from conditioned buildings. These issues are not dealt with in detail in the above mentioned documents.

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The present standard specifies how design criteria can be established and used for dimensioning of systems. It defines how to establish and define the main parameters to be used as input for building energy calculation and long term evaluation of the indoor environment. Finally this standard will identify parameters to be used for monitoring and displaying of the indoor environment as recommended in the Energy Performance of Buildings Directive.

Different categories of criteria may be used depending on type of building, type of occupants, type of climate and national differences. The standard specifies several different categories of indoor environment which could be selected for the space to be conditioned. These different categories may also be used to give an overall, yearly evaluation of the indoor environment by evaluating the percentage of time in each category. The designer may also select other categories using the principles from this standard.

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1 Scope

- This European Standard specifies the indoor environmental parameters which have an impact on the energy performance of buildings.
- The standard specifies how to establish indoor environmental input parameters for building system design and energy performance calculations.
- The standard specifies methods for long term evaluation of the indoor environment obtained as a result of calculations or measurements.
- The standard specifies criteria for measurements which can be used if required to measure compliance by inspection.
- The standard identifies parameters to be used by monitoring and displaying the indoor environment in existing buildings.
- This standard is applicable mainly in non-industrial buildings where the criteria for indoor environment are set by human occupancy and where the production or process does not have a major impact on indoor environment. The standard is thus applicable to the following building types: single family houses, apartment buildings, offices, educational buildings, hospitals, hotels and restaurants, sports facilities, wholesale and retail trade service buildings.
- The standard specifies how different categories of criteria for the indoor environment can be used. But does not require certain criteria to be used. This is up to national regulations or individual project specifications.

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- The recommended criteria in this standard can also be used in national calculation methods, which may be different to the methods referred to here.

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- The standard does not prescribe design methods, but give input parameters to the design of buildings, heating, cooling, ventilation and lighting systems.
- The standard does not include criteria for local discomfort factors like draught, radiant temperature asymmetry, vertical air temperature differences and floor surface temperatures.

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 12464-1	2002	*Light and lighting — Lighting of work places — Part 1: Indoor work places*
EN 12599		*Ventilation for buildings — Test procedures and measuring methods for handing over installed ventilation and air conditioning systems*
EN 12792	2003	*Ventilation for buildings — Symbols, terminology and graphical symbols*
EN 12831		*Heating systems in buildings — Method for calculation of the design heat load*

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EN 15193	*Energy performance of buildings — Energy requirements for lighting*
EN 15241	*Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings*
EN 15242	*Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration*
prEN 15255	*Thermal performance of buildings — Sensible room cooling load calculation — General criteria and validation procedures*
prEN 15265	*Thermal performance of buildings — Calculation of energy needs for space heating and cooling using dynamic methods — General criteria and validation procedures*
EN ISO 7726	*Ergonomics of the thermal environment — Instruments for measuring physical quantities (ISO 7726:1998)*
EN ISO 7730	*Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730:2005)*
EN ISO 8996	*Ergonomics of the thermal environment — Determination of metabolic rate (ISO 8996:2004)*
EN ISO 9920	*Ergonomics of the thermal environment — Estimation of the thermal insulation and evaporative resistance of a clothing ensemble (ISO 9920:1995)*
EN ISO 13731 2001	*Ergonomics of the thermal environment — Vocabulary and symbols (ISO 13731:2001)*
EN ISO 13790	*Thermal performance of buildings — Calculation of energy use for space heating (ISO 13790:2004)*
ISO/TS 14415	*Ergonomics of the thermal environment — Application of International Standards to people with special requirements*
CIE 69	*Methods of characterizing illuminance meters and luminance meters; performance, characteristics and specifications*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12792:2003, EN ISO 13731:2001, EN 12464-1:2002 and the following apply.

3.1
adaptation
physiological, psychological or behavioural adjustment of building occupants to the interior thermal environment in order to avoid discomfort

NOTE In naturally ventilated buildings these are often in response to changes in indoor environment induced by outside weather conditions.

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3.2
active cooling
see mechanical cooling

3.3
buildings, very low-polluting
buildings where an extraordinary effort has been done to select low-emitting materials and activities with emission of pollutants are prohibited and no previous emitting sources (like tobacco smoke) was present

NOTE Criteria are listed in Annex G.

3.4
buildings, low-polluting
buildings where an effort has been done to select low-emitting materials and activities with emission of pollutants are limited or prohibited

NOTE Criteria are listed in Annex G

3.5
buildings, not low-polluting
old or new buildings where no effort has been done to select low-emitting materials and activities with emission of pollutants not prohibited

NOTE Previous emissions (like tobacco smoke) may have taken place.

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3.6
buildings without mechanical cooling
buildings that do not have any mechanical cooling and rely on other techniques to reduce high indoor temperature during the warm season like moderately-sized windows, adequate sun shielding, use of building mass, natural ventilation, night time ventilation etc. for preventing overheating

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3.7
cooling season
part of the year during which (at least parts of the day and part of the building, usually summer) cooling appliances are needed to keep the indoor temperatures at specified levels

NOTE The length of the cooling season differs substantially from country to country and from region to region).

3.8
daylight factor (D)
ratio of the illuminance at a point on a given indoor plane due to the light received directly or indirectly from the sky of assumed or known illuminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky. The contribution of direct sunlight to both illuminances is excluded

[EN 12665:2002]

NOTE usually expressed as a percentage

3.9
demand controlled ventilation
ventilation system where the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation

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3.10
external temperature, daily mean
average of the hourly mean external air temperature for one day (24 h)

3.11
external temperature, running mean
exponentially weighted running mean of the daily mean external air temperature Θ_{ed} is such a series, and is calculated from the formula:

$$\Theta_{rm} = (1- \alpha).\{ \Theta_{ed\ -1} + \alpha.\ \Theta_{ed\ -2} + \alpha^2\ \Theta_{ed\ -3}.....\} \qquad (1)$$

This equation can be simplified to

$$\Theta_{rm} = (1- \alpha)\Theta_{ed\ -1} + \alpha.\ \Theta_{rm-1} \qquad (2)$$

Where

Θ_{rm} = Running mean temperature for today

Θ_{rm-1} = Running mean temperature for previous day

Θ_{ed-1} is the daily mean external temperature for the previous day

$\Theta_{ed\ -2}$ is the daily mean external temperature for the day before and so on.

α is a constant between 0 and 1. Recommended to use 0,8

The following approximate equation can be used where records of daily mean external temperature are not available:

$$\Theta_{rm} = (\Theta_{ed\ -1} + 0{,}8\ \Theta_{ed\ -2} + 0{,}6\ \Theta_{ed\ -3} + 0{,}5\ \Theta_{ed\ -4} + 0{,}4\ \Theta_{ed\ -5} + 0{,}3\ \Theta_{ed\ -6} + 0{,}2\ \Theta_{ed\ -7})/3{,}8 \qquad (3)$$

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3.12
heating season
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parts of the year during which (at least parts of the day and part of the building, usually winter) heating appliances are needed to keep the indoor temperatures at specified levels

NOTE The length of the heating season differs substantially from country to country and from region to region).

3.13
mechanical cooling
cooling of the indoor environment by mechanical means used to provide cooling of supply air, fan coil units, cooled surfaces, etc.

NOTE The definition is related to people's expectation regarding the internal temperature in warm seasons. Opening of windows during day and night time is not regarded as mechanical cooling. Any mechanical assisted ventilation (fans) is regarded as mechanical cooling.

3.14
optimal operative temperature
operative temperature where a maximum number of the occupants can be expected to feel the indoor temperature acceptable

NOTE For mechanical cooled building it corresponds to PMV = 0.

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3.15
occupied hours
occupied hours of the building are those when the majority of the building is in its intended use

3.16
room conditioning system
system able to keep a comfort conditions in a room within a defined range

NOTE Air conditioning as well radiant, surface heating and cooling systems are included.

3.17
ventilation rate
magnitude of outdoor air flow to a room or building either through the ventilation system or infiltration through building envelope

3.18
ventilation system
combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air

NOTE The system can consist of mechanical components (e.g. combination of air handling unit, ducts and terminal units). Ventilation system can also refer to natural ventilation systems making use of temperature differences and wind with facade grills in combination with exhaust (e.g. in corridors, toilets etc.). Both mechanical and natural ventilation can be combined with operable windows. A combination of mechanical and non-mechanical components is possible (hybrid systems).

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4 Symbols and abbreviations

Θ_o = indoor operative temperature, °C

Θ_e = external temperature, °C

q_{tot}= total ventilation rate, l/s

q_B= ventilation rate for building materials,l/(sm^2)

q_p= ventilation rate for persons, l/(s,person)

n = number of persons, -

A= floor area, m^2

$L_{p,A}$= A-weighed sound pressure level, dB(A)

$L_{p,eq,A}$=equivalent A-weighed sound pressure level, dB(A)

D = Daylight factor

$\hat{E}_m$ = Maintained (average) illuminance

E = Illuminance (at a point or surface)

R_a = Colour rendering index

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5 Interactions with other standards

The present standard both gives input to other standards and is using outputs from other standards. The diagram shows an overview of the interaction with other standards related to the EPBD.

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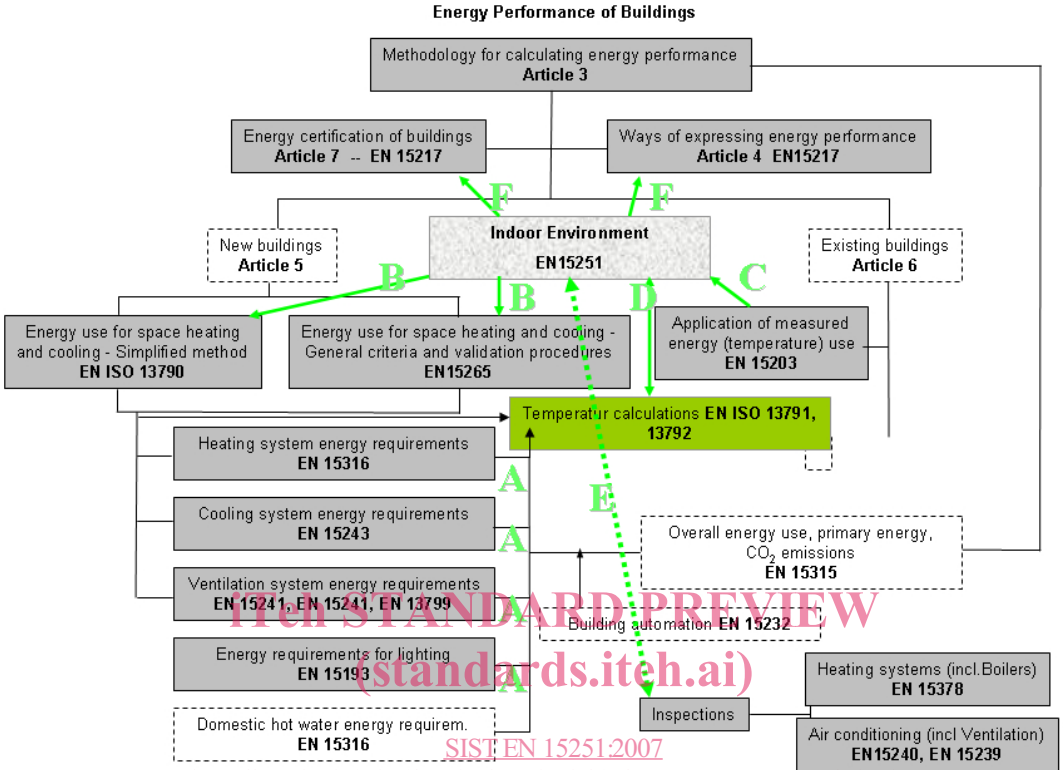

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Figure 1 — Diagram showing the interaction with other standards related to the EPBD

The present standard will interact in the following way with other standards

A It will provide indoor environmental criteria for the design of building and HVAC systems. The thermal criteria (design indoor temperature in winter, design indoor temperature in summer) are used as input for heating (EN 12831) and cooling load (prEN 15243) calculations and sizing of the equipment. Ventilation rates are used for sizing ventilation systems (Clause 6), and lighting levels for design of lighting system including the use of day lighting.

The design values for sizing the building services are needed to fulfil the requirements in the article 4 of EPBD referring to possible negative effect of indoor environment and to give advice in respect improvement of the energy efficiency of existing buildings (article 6) as well as of the heating (article 8) and cooling (article 9) of building.

B It will provide values for the indoor environment (temperature, ventilation, lighting) as input to the calculation of the energy demand (building energy demand), when the space is occupied, (EN ISO 13790, prEN 15255, prEN 15265) (Clause 7). It will also provide standardised input values which are needed for energy calculations as required calculations specified in article 3 of EPBD.

C Output from measured environmental parameters in existing buildings (prEN 15203, temperature, indoor air quality, ventilation rates) will enable the evaluation of overall annual performance (Clause 8).

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This evaluation is necessary for the display of the climatic factors (indoor environment) in the energy performance certificate (article 6 and 7 of EPBD).

D Output from room temperature calculations (EN ISO 13791, EN ISO 13792) will enable evaluation of the annual performance of buildings (Clause 8). This evaluation is necessary for the display of climatic factors (indoor environment) in the energy performance certificate (article 7 of EPBD) when the evaluation is based on calculations (article 7 of EPBD).

E It will provide methods for measurement of the indoor environment and for treating measured data related to the inspection of HVAC systems (EN 15240, EN 15239, prEN 15378) (Clause 9). This information is necessary to give advice related to the heating loads and system (article 8 of EPBD) and air conditioning load and system (article 9 of EPBD) of a building.

F It will provide a method for categorisation of indoor environment (prEN 15217) (Clause 10). This method is necessary to integrate complex indoor environment information to simple classification for the energy certificate (article 7 of EPBD).

Recommended input values are given for each of the different categories. A short description of the categories is shown in Table 1.

Table 1 — Description of the applicability of the categories used

Category	Explanation
I	High level of expectation and is recommended for spaces occupied by very sensitive and fragile persons with special requirements like handicapped, sick, very young children and elderly persons
II	Normal level of expectation and should be used for new buildings and renovations
III	An acceptable, moderate level of expectation and may be used for existing buildings
IV	Values outside the criteria for the above categories. This category should only be accepted for a limited part of the year

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NOTE In other standards like EN 13779 and EN ISO 7730 categories are also used; but may be named different (A, B, C or 1, 2, 3 etc.)

6 Design input criteria for dimensioning of buildings, heating, cooling, mechanical and natural ventilation systems

6.1 General

For design of buildings and dimensioning of room conditioning systems the thermal comfort criteria (minimum room temperature in winter, maximum room temperature in summer) shall be used as input for heating load (EN 12831) and cooling load (prEN 15255) calculations. This will guarantee that a minimum-maximum room temperature can be obtained at design outdoor conditions and design internal loads. Ventilation rates that are used for sizing the equipment shall be specified in design (EN 15241, EN 15242). This clause presents input values for the sizing and dimensioning of the systems as well as for design of buildings without mechanical cooling.