SLOVENSKI STANDARD
oSIST prEN 16798-1:2015

01-september-2015

Energetska učinkovitost stavb - 1. del: Vstopni podatki notranjega okolja za načrtovanje in ocenjevanje energetske učinkovitosti stavb z upoštevanjem notranje kakovosti zraka, toplotnega okolja, razsvetljave in akustike - Modul M1-6

Energy performance of buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6

Energieeffizienz von Gebäuden - Teil 1: Eingangsparameter für das Raumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden Raumluftqualität, Temperatur, Licht und Akustik - Modul M1-61)

Performance énergétique des bâtiments - Partie 1 : Critères d'ambiance intérieure pour la conception et l'évaluation de la performance énergétique des bâtiments couvrant la qualité de l'air intérieur, l'ambiance thermique, l'éclairage et l'acoustique - Module M1-6

Ta slovenski standard je istoveten z: **prEN 16798-1**

ICS:

91.120.10	Toplotna izolacija stavb	Thermal insulation
91.140.01	Napeljave v stavbah na splošno	Installations in buildings in general

oSIST prEN 16798-1:2015 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 16798-1

May 2015

ICS 91.120.10; 91.140.01

Will supersede EN 15251:2007

English Version

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

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Foreword

This document (prEN 16798-1:2015) has been prepared by Technical Committee CEN/TC 156 “Ventilation for Buildings”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15251:2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Introduction

Energy consumption of buildings depends significantly on the criteria used for the indoor environment (heating, cooling, 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. There is therefore a need for specifying criteria for the indoor environment for design and energy calculations for buildings and building service systems.

The present standard is a revision of EN15251-2007. There exist other national and international standards, and technical reports, which specify criteria for thermal comfort and indoor air quality (EN ISO 7730, CR1752). 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. Studies have shown that occupant expectations in natural ventilated buildings may differ from conditioned buildings, which will be part of this standard

The present standard specifies how design criteria shall 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 short 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 conditions. The Standard specifies several different categories of indoor environment which could be selected for the space to be conditioned. These different categories can be used for design and may also be used to give an overall, yearly evaluation of the indoor environment by evaluating the percentage of time in each category.

1 Scope

- This European Standard deals with the indoor environmental parameters for thermal environment, indoor air quality, lighting and acoustic.
- This standard specifies how to establish indoor environmental input parameters for building system design and energy performance calculations.
- This standard includes design criteria for the local thermal discomfort factors. draught, radiant temperature asymmetry, vertical air temperature differences, floor surface temperature.
- This standard is applicable 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.
- This standard specifies occupancy schedules to be used in standard energy calculations.
- This 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.

- The criteria in this standard can also be used in national calculation methods. This standard sets criteria for the indoor environment based on existing standards and reports listed under normative references or in the bibliography.

- The standard does not prescribe design methods, but give input parameters to the design of buildings, heating, cooling, ventilation and lighting systems

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 7726, *Ergonomics of the thermal environment – Instruments for measuring physical quantities*

EN ISO 7730, Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort

EN ISO 8996, *Ergonomics – Determination of metabolic heat production*

EN ISO 9920, *Ergonomics of the thermal environment – estimation of the thermal insulation and evaporative resistance of a clothing ensemble*

EN ISO 1373, *Ergonomics of the thermal environment - Definitions, symbols and units.*

EN ISO 13790, *Thermal performance of buildings – Calculation of energy use for space heating and cooling – Simplified method*

EN ISO 13791, *Thermal Performance of Buildings — Calculation of Internal Temperatures in a Room in Summer without Mechanical Cooling — General Criteria and Validation Procedures*

EN ISO 13792, *Thermal performance of buildings — Internal temperature of a room in summer without mechanical cooling — Simplified calculation methods*

EN 12193, *Light and lighting – Sports Lighting*

EN 12792, *Ventilation for Buildings — Symbols, Terminology and Graphical Symbols*

EN 12831, *Heating systems in buildings-Calculation of the heating load*

EN 12464-1, *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 12665, *Light and Lighting – Basic terms and criteria for specifying data of lamps and luminaries*

EN 13032-1, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaries*

EN 13141 parts 1-11, *Ventilation for buildings - Performance testing of components/products for residential ventilation*

EN 13779, *Ventilation for non-residential buildings - performance requirements for ventilation and room-conditioning systems*

EN 13142, *Ventilation for buildings - Components/products for residential ventilation - Required and optional performance characteristics*

PrEN 14788, *Ventilation for buildings – Design and dimensioning of residential ventilation systems*

prEN 15193-1, *Energy performance of buildings - Energy requirements for lighting*

EN 15203, *Energy performance of buildings — Assessment of energy use and definition of ratings*

EN 15217, *Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings*

EN 15239, *Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration*

EN 15240, *Energy performance of buildings – Guidelines for the inspection of air-conditioning systems*

EN 15241, *Ventilation for buildings — Energy performance of buildings – Guidelines for the inspection of ventilation systems*

EN 15242, *Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration*

EN 15243, *Dynamic calculation of room temperatures and of load and energy for buildings with room conditioning systems (including solar shading, passive cooling, position and orientation*

EN 15255, *Thermal performance of buildings – Sensible room cooling load calculation – General criteria and validation procedures*

EN 15265, *Energy performance of buildings – Calculation of energy use for space heating and cooling – General criteria and validation procedures*

EN 15378, *Energy performance of buildings – Systems and methods for the inspection of boilers and heating systems*

ISO 15927-4, *Hygrothermal performance of buildings-Calculation and presentation of climatic data – Part 4: Data for assessing the annual energy for cooling and heating systems and Part 5: Winter external temperatures and related wind data*

EN 15665, *Ventilation for buildings - Determining performance criteria for residential ventilation systems*

ISO/TS 14415, *The Application of International Standards for People with Special Requirements*

CR 1752:2001, *Ventilation for buildings – Design criteria for the indoor environment*

CIE 69:1987, *Methods for characterizing illuminance meters and luminance meters: Performance, characteristics and specifications*

3 Terms and definitions

For the general purposes of this European Standard, the terms and definitions given in EN 12792, EN ISO 13731 and EN 12464, EN12665 and EN15603 shall apply.

3.1
Adaptation, thermal
Physiological, psychological or behavioural adjustment of building occupants to the interior thermal environment in order to avoid or to limit thermal discomfort. In naturally ventilated buildings these are often in response to changes in indoor environment induced by outside weather conditions.

3.1.1
Adaptation, Perceived Air Quality
Sensory adaptation to perceived air quality (odour), which occurs during the first 15 min. exposure to bioeffluents.

3.2
Active cooling
See mechanical cooling.

3.4
Buildings, Very Low-Polluting
A building where predominantly low-emitting materials and furniture are used and activities with emission of pollutants are prohibited and no previous emitting sources (like tobacco smoke) was present. Criteria are listed in Annex B3.

3.5
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. Criteria are listed in Annex B3.

3.6
Buildings, non 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. Previous emissions (like tobacco smoke) may have taken place.

3.7
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.

3.8
Cooling season
Parts of the year during which (usually summer), at least parts of the day and part (some rooms) of the building, cooling are needed to keep the indoor temperatures at specified levels.

Note 1 to entry: The length of the cooling season differs substantially from country to country and from region to region).

3.9
Daylight factor
Ratio of the illuminance at a point on a given plane due to the light received directly or indirectly from a sky of assumed or known luminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky, excluding the contribution of direct sunlight to both illuminances. [EN 12665:2011]

3.10
Demand controlled ventilation
A ventilation system where the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation.

3.11
External temperatures, daily mean
The average of the hourly mean external air temperature for one calendar day (24 hours)

3.12
External temperature, running mean
The exponentially weighted running mean of the daily mean external air temperature Θ_{ed}

3.13
Heating season
Parts of the year during which (at least parts of the day and part of (some rooms) the building,) heating appliances are needed to keep the indoor temperatures at specified levels.
Note 1 to entry: The length of the heating season differs substantially from country to country and from region to region).

3.14
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.

3.15
Occupied hours
The occupied hours of the building are those when the majority of the considered part of the building is in its intended use.

3.16
Operative temperature
The uniform temperature of an imaginary black enclosure in which an occupant would exchange the same amount of heat by radiation plus convection as in the actual non-uniform environment

3.17 Optimal operative temperature
The operative temperature that satisfies the greatest possible number of people at a given clothing and activity level with the thermal environment.

3.18
Room Conditioning System
A system installed and used to keep a comfort conditions in a room within a defined range. Air conditioning as well radiant, surface heating and cooling systems are included.

3.19
Room Temperature
Is defined as Room Operative Temperature

3.20
Ventilation rate
The magnitude of outdoor air flow to a room or building through the ventilation system and infiltration through building envelope.

3.21
Ventilation system
A combination of appliances designed to supply indoor spaces with outdoor air and to extract polluted indoor air. Ventilation system refers to mechanical, natural and hybrid ventilation systems.

3.22
Design ventilation airflow rate
Ventilation rate that the system shall be able to provide (including boost).

4 Symbols and abbreviations

θ_o = indoor operative temperature, °C

θ_e = external temperature, °C

Θ_{rm-i} = Running mean external temperature

Θ_{ed-i} = daily mean external temperature

α= constant for running mean calculations

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 per person)

n = number of persons, -

Q_h = ventilation rate required for dilution, in litre per second;

G_h = pollution load of a pollutant, in micrograms per second;

$C_{h,}$ = guideline value of a pollutant, in micrograms per litre;

$C_{h,o}$ = supply concentration of a pollutant at air intake, in micrograms per litre;

ε_v = ventilation effectiveness (EN13779)

A= floor area, m^2

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

$L_{eq,\ nT,A}$ = Equivalent continuous sound pressure level

D = Daylight factor

E = Illuminance (at a point or surface), lx

R_a = Colour rendering index

UGR = Unified Glare Rating

PPD = Predicted Percentage of Dissatisfied, %

PMV = Predicted Mean Vote

DR = Draught Rate, %

Daylight factor DCa,j

Daylight factor DSNA

5 Interactions with other standards

The present standard will provide indoor environmental criteria for the design of buildings, room conditioning systems and lighting systems. The thermal criteria (PMV or design indoor temperature in winter, design indoor temperature in summer) are used as **input for** heating (EN12831) and cooling load (EN 15243) calculations and **sizing of** equipment. Ventilation rates are used for sizing ventilation systems, and lighting levels for design of lighting system including the use of day lighting (EN12464-1)

The present standard will provide values for the indoor environment (like temperature, ventilation rate, illuminance) as **input to** the calculation of the **energy demand** (building energy demand), when the space is occupied, (EN ISO 13790, EN 15255, EN 15265, EN15193) (Section 7).

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 also recommended for spaces occupied by very sensitive and fragile persons with special requirements like some disabilities, sick, very young children and elderly persons, to increase accessibility.
II	Normal level of expectation
III	An acceptable, moderate level of expectation
IV	Low level of expectation. This category should only be accepted for a limited part of the year

Table 2 shows the relative position of this standard within the EN EPB set of standards.

Table 2 — Position of this standard within the EN EPB set of standards according to EN15603

Overarching		Building (as such)		Technical Building Systems										
	Descriptions		Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation & control	PV, wind, ..
subB1	M1	subB1	M2	subB1		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General	1	General	1	General									
2	Common terms and definitions; symbols, units and subscripts	2	Building Energy Needs	2	Needs									
3	Applications	3	(Free) Indoor Conditions without Systems	3	Maximum Load and Power									
4	Ways to Express Energy Performance	4	Ways to Express Energy Performance	4	Ways to Express Energy Performance									
5	Building Functions and Building Boundaries	5	Heat Transfer by Transmission	5	Emission & control									
6	Building Occupancy and Operating Conditions	6	Heat Transfer by Infiltration and Ventilation	6	Distribution & control									
7	Aggregation of Energy Services and Energy Carriers	7	Internal Heat Gains	7	Storage & control									
8	Building Partitioning	8	Solar Heat Gains	8	Generation & control									
9	Calculated Energy Performance	9	Building Dynamics (thermal mass)	9	Load dispatching and operating conditions									
10	Measured Energy Performance	10	Measured Energy Performance	10	Measured Energy Performance									
11	Inspection	11	Inspection	11	Inspection									
12	Ways to Express Indoor Comfort			12	BMS									
13	External Environment Conditions													
14	Economic Calculation													

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

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 (EN12831) and cooling load (EN15253) calculations. Ventilation rates that are used for sizing the equipment shall be specified in design (EN13779, EN15241, and EN15242). The criteria in this section shall be used as input values for the sizing and dimensioning of the systems as well as for design of buildings without mechanical cooling.

Criteria specified in national building codes for design and dimensioning of systems must be used. The present standard gives, in informative annexes, recommended input values for use in cases where no national regulation are available. The recommended criteria are given for several categories. Design criteria for the indoor environment shall be documented by the designer together with the premises for use of the spaces. .

6.1 Thermal environment

6.1.1 Mechanically heated and/or cooled buildings

For establishing design criteria the following procedure shall be used.

Criteria for the thermal environment in heated and/or cooled buildings shall be based on the thermal comfort indices PMV-PPD (predicted mean vote - predicted percentage of dissatisfied) with assumed typical levels of activity and typical values of thermal insulation for clothing (winter and summer) as described in detail in EN ISO 7730. Based on the selected criteria (see Table B1.1-1 for intended comfort category) a corresponding design operative temperature interval is established. The values for dimensioning of cooling systems are the upper values of the comfort range during cooling season (summer) and values for dimensioning of the heating system are the lower values of the comfort range. Some examples of recommended design indoor operative temperatures for heating and cooling, derived according to this principle, are presented in Annex B1.1 Table B1.1.-2 and in TR15251

The design criteria in this section shall be used for both design of buildings (dimensioning of windows, solar shading, building mass etc.) and HVAC systems.

Instead of using operative temperature as the design criterion the PMV-PPD index can be used directly. In this way the effect of increased air velocity and effect of dynamic clothing insulation can be taken into account.

Selection of the category is building specific, and the needs of special occupant groups such as elderly people (low metabolic rate and impaired control of body temperature) shall be considered (ISO/TS14415). For this group of people it is recommended to use category I requirements.

For buildings and spaces were the mechanical cooling capacity is not adequate to meet the required temperature categories the design documents must state, using one of the methods described in TR15251, how often the conditions are outside the required range.

6.1.1.1 Local thermal discomfort

Criteria for local thermal discomfort such as draught, radiant temperature asymmetry, vertical air temperature differences and floor surface temperatures shall also be taken into account when designing buildings and HVAC systems. Table B1.1.-3 presents the most important local thermal discomfort criteria at three category levels. For more background information see TR15251.