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Criteria for the Indoor Environment including thermal, indoor air quality, light and noise

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Foreword

This document (prEN 15251:2005) 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.

Introduction

Energy consumption of buildings depends significantly on the used criteria 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 the deteriorated indoor environment for the society, employer and building owner are often higher than the cost of energy used in the same buildings. 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.

There exist several international standards and guidelines, which specify criteria for thermal comfort and air quality (EN ISO 7730, CR1752, and EN 13779). These standards do however specify different classes, 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 HVAC systems. They can not directly be used for a whole year evaluation of the indoor thermal environment. New results have shown that occupant expectations in natural ventilated buildings may differ from conditioned buildings. This is not dealt with in details in the above documents.

This standard specifies how design criteria shall be used for dimensioning of systems. It will also define how to establish and define parameters of main impact or classes to be used as input to building energy calculation methods and long term evaluation of the indoor environment.

Standard specifies the three categories of indoor environment which shall be selected for a space to be conditioned. Category A corresponds to a high level of expectation (and leads to a highest percentage of satisfied occupants in respect of indoor environment), category B a medium level of expectation and category C to a moderate level of expectation. The designer may also select different levels using the same principles. A different category may be selected for thermal environment, the indoor air quality, acoustic environment and lighting for a space or a building. A different category may be selected for summer and winter.

1 Scope

— This European Standard specifies the parameters of impact and/or criteria for indoor environment and how they are used to meet the intent in the EPBD.

— The standard specifies how to establish indoor environmental input parameters for the building system design and energy performance calculations.

— The standard also specifies methods for long term evaluation of the obtained indoor environment as a result of calculations or measurements.

— The standard includes a special section for buildings without mechanical cooling.

— The standard specifies criteria for measurements to be used by inspection or monitoring of the indoor environment in existing buildings.

— This standard is applicable mainly in the 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 indoor environment can be used. But does not does not require the certain criteria to be used. This is up to national or individual project specifications.

The parameters and criteria are based on existing Standards and Guidelines (such as ISO CD16814, EN ISO 7730, EN 13779, CR1752, and existing national standards).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

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

EN 12792: 2004, *Symbols, units and terminology*

EN ISO 7726: 2003, *Ergonomics of the thermal environment — Instruments for measuring physical quantities*

ISO EN 7730: 2005, *Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort*

EN ISO 8996: 2004, *Ergonomics — Determination of metabolic heat production*

ISO EN 9920: 2004, *Ergonomics of the thermal environment — estimation of the thermal insulation and evaporative resistance of a clothing ensemble*

EN13779: 2004, *Ventilation for non-residential buildings — performance requirements for ventilation and room-conditioning systems*

EN12831: 2003, *Heating systems in buildings — Calculation of the heating load*

EN 12464: 2002, *Light and lighting — Lighting of work places — Part 1: Indoor work places*

EN 12665: 2002, *Light and Lighting — Basic terms and criteria for specifying data of lamps and luminaries*

EN 13032: 2004, *Light and lighting — Measurement and presentation of photometric data of lamps and luminaries*

ISO 15927-4: 2004, *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*

PrEN14788: 2004, *Ventilation for buildings — Design and dimensioning of residential ventilation systems*

3 Terms and definitions

For the general purposes of this European Standard, the terms and definitions given in EN 12792 shall apply.

3.1
adaptation
physiological, psychological or behavioural adjustment of building occupants to the interior thermal environment, induced by outside weather conditions

3.2
active cooling
see mechanical cooling

3.3
average outdoor temperature
average daily outdoor temperature is the average of hourly average outdoor air temperatures
Average monthly outdoor temperature is the average of average daily outdoor air temperatures

3.4
brightness contrast
subjective assessment of the difference in colour between two or more surfaces seen simultaneously or successively

3.5
buildings without mechanical cooling
buildings that rely on passive techniques to reduce high indoor temperature during the warm season like not too large windows, adequate sun shielding, use of building mass, nigh time ventilation etc. and not mechanical systems (e.g. air cooling, cooled surfaces) for preventing overheating

3.6
cold season
see heating season. In most regions (depending on length of the day, local solar radiation levels, average monthly wind speed etc.) the cold season usually refers to periods with average outside temperatures (average between maximum day temperature and minimum night temperature) below 12…13 °C

3.7
colour rendering
effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under a reference illuminant

3.8
colour rendering index (R_a)
mean of the CIE 1974 special colour rendering indices for a specific set of eight test colour samples (IEC 50 (845)/CIE 17.4:1987; 845-02-59)

3.9
cooling season
part of the year during which (at least parts of the day) cooling appliances are used to keep the indoor temperatures at agreed levels. The length of the cooling seasons differs substantially from country to country (region to region)

3.10
daylight factor (D)
ratio of the luminance at a point on a given plane due to the light received directly or indirectly from the sky of assumed or known luminance distribution, to the luminance on a horizontal plane due to an unobstructed hemisphere of this sky. The contribution to direct sunlight to both luminances is excluded

3.11
demand controlled ventilation
in demand controlled ventilation system the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation

3.12
glare
condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or to extreme contrasts

3.13
heating season
part of the year during which (at least parts of the day) heating appliances are used to keep the indoor temperatures at agreed levels. The length of the heating seasons differs substantially from country to country (region to region)

3.14
luminance (at a point or surface) (E)
quotient of the luminous dΦ incident on an element of the surface containing the point, by the area dA of that element

3.15
maintained (average) luminance ($\hat{E}_m$)
value below which the average luminance on the specified area should not fall. It is the average luminance at the time maintenance should be carried out

3.16
mechanical cooling
cooling of an environment or building by mechanical means like compressor cycle or similar using central cooling of supply air, fan coil units, cooled surfaces, etc.

3.17
mechanical ventilation
see under ‘ventilation system’

3.18
natural ventilation
see under 'ventilation system'

3.19
occupied hours/Unoccupied hours
the occupied hours of the building are those when the majority of the building is in its intended use. The hours outside this period building is considered to be unoccupied

3.20
shielding angle
angle between the horizontal planes at the first line of sight at which the luminous parts of the lamps in the luminaries are directly visible

3.21
ventilation rate
the magnitude of outdoor air flow to a room or building either through the ventilation system of infiltration through building envelope

3.22
ventilation system
a combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air. 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 (wind dependant) facade shutters in combination with mechanical 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)

3.23
warm season
see cooling season. In most regions (depending on length of the day, local solar radiation levels, average monthly wind speed etc.) the warm season usually refers to periods with average outside temperatures above 12…13 °C

3.24
unified Glare Rating (UGR)
rating of discomfort glare directly forms the luminaries of an indoor lighting installation using the CIE Unified Glare Rating tabular method (EN 12464-1:2002)

4 Symbols and abbreviations

T = temperature, ^{o}C

T_o = indoor operative temperature, ^{o}C

T_e = external temperature, ^{o}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,pers

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) luminance

E = Luminance (at a point or surface)

R_a = Colour rendering index

UGR = Unified Glare Rating

5 Interactions with other standards

The present standard both give 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.

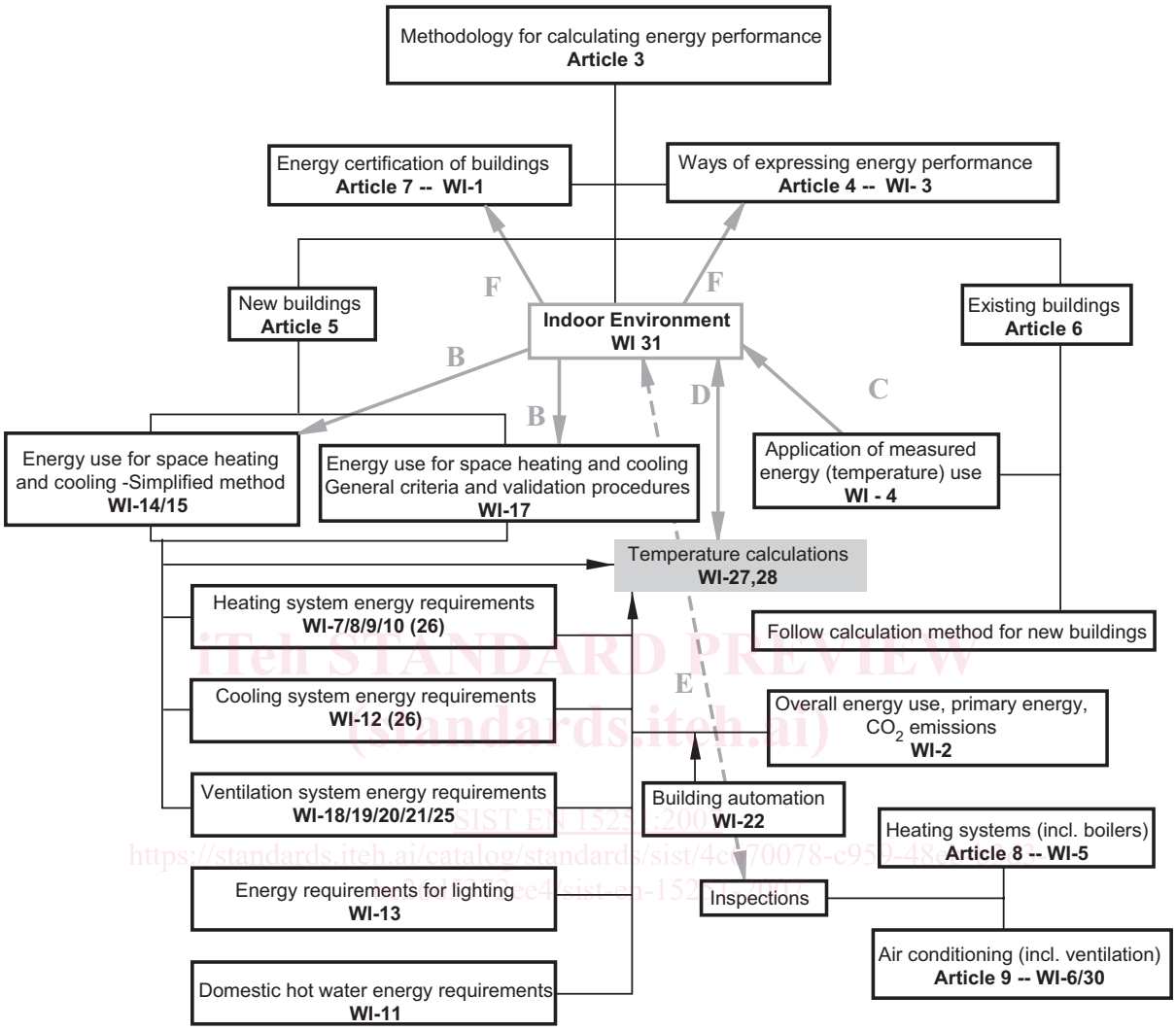

Figure 1 — Diagram showing the interaction with other standards related to the EPBD

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

A Indoor environmental criteria for 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 (EN12831) and cooling load (EPBD-WI-16) calculations and **sizing of** the equipment. Ventilation rates are used for sizing ventilation systems (Section 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 Criteria for the indoor environment (temperature, ventilation, lighting) as **input to** the calculation of the **energy demand** (building energy demand), (EPBD WI-14, EPBD WI-15, EPBD WI-17) (Section 7).