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Energy performance of buildings - Part 2: 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 - Technical report - Interpretation of the requirements in EN 16798-1

erman title: Energieeffizienz von Gebäuden - Teil 2: Eingangsparameter für das Innenraumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden bezüglich Raumluftqualität, Temperatur, Licht und Akustik - Module M1-6 - Technischer Bericht - Interpretation der Anforderungen der EN 16798-1

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Performance énergétique des bâtiments - Partie 2 : Critères d'ambiance intérieure pour la conception et l'évaluation de la performance énergétique des bâtiments couvrant la qualité de l'air intérieur, la thermique, l'éclairage et l'acoustique - Module M1-6 - Rapport technique - Interprétation des exigences de l'EN 16798-1

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**Energy performance of buildings - Part 2: 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 - Technical report - Interpretation
of the requirements in EN 16798-1**

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l'EN 16798-1

Energieeffizienz von Gebäuden - Teil 2:
Eingangsparameter für das Innenraumklima zur
Auslegung und Bewertung der Energieeffizienz von
Gebäuden bezüglich Raumluftqualität, Temperatur,
Licht und Akustik - Module M1-6 - Technischer Bericht
- Interpretation der Anforderungen der EN 16798-1

This draft Technical Report is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 156.

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European foreword

This document (FprCEN/TR 16798-2:2016) 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 Vote on TR.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document is part of the set of standards and accompanying Technical Reports on the energy performance of buildings and has been prepared under the Mandate M 480 given to CEN by the European Commission and the European Free Trade Association, see Bibliographical Reference [35]).

Directive 2010/31/EU recasting the Directive 2002/91/EC on energy performance of buildings (EPBD, [36]) promotes the improvement of the energy performance of buildings within the European Union, taking into account all types of energy uses (heating, lighting, cooling, air conditioning, ventilation) and outdoor climatic and local conditions, as well as indoor climate requirements and cost effectiveness (Article 1).

The directive requires Member States to adopt measures and tools to achieve the prudent and rational use of energy resources. In order to achieve those goals, the EPBD requires increasing energy efficiency and the enhanced use of renewable energies in both new and existing buildings. One tool for this is the application by Member States of minimum requirements on the energy performance of new buildings and for existing buildings that are subject to major renovation, as well as for minimum performance requirements for the building envelope if energy-relevant parts are replaced or retrofitted. Other tools are energy certification of buildings, inspection of boilers and air-conditioning systems.

The use of European standards increases the accessibility, transparency and objectivity of the energy performance assessment in the Member States facilitating the comparison of best practices and supporting the internal market for construction products. The use of EPB-standards for calculating energy performance, as well as for energy performance certification and the inspection of heating systems and boilers, ventilation and air-conditioning systems will reduce costs compared to developing different standards at national level.

The first mandate to CEN to develop a set of CEN EPBD standards (M/343, [34]), to support the first edition of the EPBD ([33]) resulted in the successful publication of all EPBD related CEN standards in 2007-2008.

The Mandate M/480 was issued to review the Mandate M/343 as the recast of the EPBD raised the need to revisit the standards and reformulate and add standards so that they become on the one hand unambiguous and compatible, and on the other hand a clear and explicit overview of the choices, boundary conditions and input data that need to be defined at national or regional level. Such national or regional choices remain necessary, due to differences in climate, culture and building tradition, policy and legal frameworks. Consequently, the set of CEN-EPBD standards published in 2007-2008 had to be improved and expanded on the basis of the recast of the EPBD.

The EPB standards are flexible enough to allow for necessary national and regional differentiation and facilitate Member States implementation and the setting of requirements by the Member States.

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Further target groups are users of the voluntary common European Union certification scheme for the energy performance of non-residential buildings (EPBD art.11.9) and any other regional (e.g. Pan European) parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

For the convenience of Standards users CEN/TC 156, together with responsible Working Group Conveners, have prepared a simple table below relating, where appropriate, the relationship between the 'EPBD' and 'recast EPBD' standard numbers prepared by Technical Committee CEN/TC 156 "Ventilation for buildings".

EPBD EN Number	Recast EPBD EN Number	Title
EN 15251	EN 16798-1	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 (revision of EN 15251)
N/A	CEN/TR 16798-2	Energy performance of buildings — Part 2: 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 — Technical report — Interpretation of the requirements in EN 16798-1
EN 13779	EN 16798-3	Energy performance of buildings — Part 3: Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems (revision of EN 13779)
N/A	CEN/TR 16798-4	Energy performance of buildings — Part 4: Ventilation for non-residential buildings — Performance requirements for ventilation, air conditioning and room-conditioning systems — Technical Report — Interpretation of the requirements in EN 16798-3
EN 15241	EN 16798-5-1	Energy performance of buildings — Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 — Ventilation for buildings — Calculation methods for energy requirements of ventilation and air conditioning systems — Part 5-1: Distribution and generation — Method 1 (revision of EN 15241)
EN 15241	EN 16798-5-2	Energy performance of buildings — Modules M5-6.2, M5-8.2 — Ventilation for buildings — Calculation methods for energy requirements of ventilation systems — Part 5-2: Distribution and generation — Method 2 (revision of EN 15241)

N/A	CEN/TR 16798-6	Energy performance of buildings — Part 6: Ventilation for buildings — Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 — Calculation methods for energy requirements of ventilation and air conditioning systems — Technical report — Interpretation of the requirements in EN 16798-5-1 and EN 16798-5-2
EN 15242	EN 16798-7	Energy performance of buildings — Part 7: Ventilation for buildings — Modules M5-1, M5-5, M5-6, M5-8 — Calculation methods for the determination of air flow rates in buildings including infiltration (revision of EN 15242)
N/A	CEN/TR 16798-8	Energy performance of buildings — Part 8: Ventilation for buildings — Modules M5-1, M5-5, M5-6, M5-8 — Calculation methods for the determination of air flow rates in buildings including infiltration — Technical report — Interpretation of the requirements in EN 16798-7
EN 15243	EN 16798-9	Energy performance of buildings — Part 9: Ventilation for buildings — Module M4-1, M4-4, M4-9 — Calculation methods for energy requirements — Calculation methods for energy requirements of cooling systems — General (revision of EN 15243)
N/A	CEN/TR 16798-10	Energy performance of buildings — Part 10: Ventilation for buildings — Methods for the calculation of the energy performance of cooling systems — General — Technical report — Interpretation of the requirements in EN 16798-9 — Modules M4-1, M4-4, M4-9
N/A	EN 16798-13	Energy performance of buildings — Part 13: Module M4-8 — Calculation of cooling systems — Generation
N/A	CEN/TR 16798-14	Energy performance of buildings — Part 14: Module M4-8 — Calculation of cooling systems — Generation — Technical report — Interpretation of the requirements in EN 16798-13
N/A	EN 16798-15	Energy performance of buildings — Part 15: Module M4-7 — Calculation of cooling systems — Storage
N/A	CEN/TR 16798-16	Energy performance of buildings — Module M4-7 — Calculation of cooling systems — Storage — Part 16: Technical report — Explanation of the requirements of EN 16798-15
EN 15239 and EN 15240	EN 16798-17	Energy performance of buildings — Part 17: Ventilation for buildings — Guidelines for inspection of ventilation and air conditioning systems, Module M4-11, M5-11, M6-11, M7-11

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N/A	CEN/TR 16798-18	Energy performance of buildings — Part 18: Ventilation for buildings — Module M4-11, M5-11, M6-11, M7-11 — Guidelines for inspection of ventilation and air-conditioning systems — Technical report — Interpretation of the requirements in EN 16798-17
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Introduction

This Technical Report is a guide to prEN 16798-1 and can help the user in application of the standard and give additional background information. Besides this Technical Report describes and recommends additional topics related to the evaluation of the indoor environmental quality and new possibilities to improve the indoor environmental quality and reduce energy use of buildings like personalized systems, air cleaning technologies, consideration of adapted persons, etc.

This Technical Report explains how design criteria can be established and used for dimensioning of systems. It explains 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. This Technical Report also describes how gas phase air cleaning in the future can improve the indoor air quality and partly substitute for outside air. Finally it will identify parameters to be used for monitoring and displaying of the indoor environment. Different categories of criteria can be used depending on type of building, type of occupants, type of climate and national differences. The report explains how these different categories of indoor environment can be individually selected as national criteria, be used in project agreement for design criteria and for displaying the yearly building performance in relation to indoor environmental quality. The designer can also define other categories using the principles from prEN 16798-1 and this Technical Report.

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1 Scope

This European Technical Report deals with the indoor environmental parameters for thermal environment, indoor air quality, lighting and acoustic. The Technical Report explains how to use prEN 16798-1 for specifying indoor environmental input parameters for building system design and energy performance calculations. The Technical Report specifies methods for long term evaluation of the indoor environment obtained as a result of calculations or measurements. The report specifies criteria for measurements which can be used if required to measure compliance by inspection. The Technical Report identifies parameters to be used by monitoring and displaying the indoor environment in existing buildings. This Technical Report 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. The Technical Report explains how different categories of criteria for the indoor environment can be used.

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.

NOTE The references in prEN 16798-1 are also applicable in this Technical Report. Additional references are listed in the Bibliography.

- EN 12193, *Light and lighting — Sports lighting*
- EN 12464-1:2011, *Light and lighting — Lighting of work places — Part 1: Indoor work places*
- EN 12464-2, *Light and lighting — Lighting of work places — Part 2: Outdoor work places*
- EN 12665, *Light and lighting — Basic terms and criteria for specifying lighting requirements*
- EN 12792, *Ventilation for buildings — Symbols, terminology and graphical symbols*
- EN 15378:2007, *Heating systems in buildings — Inspection of boilers and heating systems*
- EN 15603, *Energy performance of buildings — Overall energy use and definition of energy ratings*
- prEN 16798-1:2015, *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*
- prEN 16798-3, *Energy performance of buildings — Part 3: Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems*
- 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)*
- EN ISO 10052, *Acoustics — Field measurements of airborne and impact sound insulation and of service equipment sound — Survey method (ISO 10052)*
- EN ISO 16032, *Acoustics — Measurement of sound pressure level from service equipment in buildings — Engineering method (ISO 16032)*

EN ISO 13731, *Ergonomics of the thermal environment — Vocabulary and symbols (ISO 13731)*

FprEN ISO 52000-1:2016, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures (ISO/FDIS 52000-1:2016)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 16798-1, EN 12792, EN ISO 13731, EN 12464 (all parts), EN 12665 and EN 15603 apply.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this Report, the symbols given in FprEN ISO 52000-1:2016, Clause 4 and Annex C and the specific symbols listed in Table 1 apply.

Table 1 — Symbols and units

Symbol	Quantity	Unit
θ_o	indoor operative temperature	°C
θ_e	outdoor temperature	°C
Θ_m	running mean outdoor air temperature	°C
θ_{ed-i}	daily mean outdoor temperature	°C
Θ_o	operative temperature, design and energy calculations	°C
θ_{rm-i}	running mean outdoor temperature	°C
θ_{ed-i}	daily mean outdoor temperature	°C
v_a	air speed (average/maximum)	m/s
Θ_f	floor surface temperature	°C
ΔCO_2	concentration	ppm
$\Delta \Theta_{pr}$	radiant temperature asymmetry	K
$\Delta \Theta_a$	vertical air temperature difference	K
α	constant for running mean calculations	
q_{tot}	total ventilation rate	l/s
q_B	ventilation rate for building materials	l/s (m ²)
q_p	ventilation rate for persons	l/s (per person)
q_{tot}	total ventilation rate in occupied zone	l/s (m ²), l/s (person)
n	number of persons	
q_h	ventilation rate required for dilution of pollutant	L/s
G_h	generation of a pollutant	µg/s

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Symbol	Quantity	Unit
C_h	guideline value of a pollutant	$\mu\text{g/L}$
$C_{h,i}$	guideline value of the substance	$\mu\text{g}/\text{m}^3$
$C_{h,o}$	supply concentration of a pollutant at air intake	$\mu\text{g/L}$
ε_v	ventilation effectiveness	-
A	floor area	m^2
$L_{p,A}$	A-weighted sound pressure level	dB(A)
$L_{\text{eq},nT,A}$	equivalent continuous sound pressure level	dB(A)
D	daylight factor	
DC_{aj}	daylight quotient of the Calculated area	j
E_m	average maintained illuminance	lx
M	activity level	met
I_{cl}	assumed clothing level winter/summer	clo

4.2 Abbreviations

Table 2 — Abbreviations

Abbreviation	Term
ACH	air changers per hour
DR	draught rate, %
DSNA	daylight quotient sunscreen not activated
IEQ	indoor environmental quality
IEQ_{cat}	indoor environmental quality category for design
LPB_{1-3}	low polluting building class
PD	percentage dissatisfied for local thermal discomfort
PMV	predicted mean vote
PPD	predicted percentage of dissatisfied, %
RH	relative humidity
WHO	World Health Organization

5 Interactions with other standards and use of categories

The present Technical Report interacts mainly with prEN 16798-1 and indirectly with the standards that interact with prEN 16798-1.

The Technical Report explains how the indoor environmental criteria in prEN 16798-1 can be used 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 and cooling load calculations and sizing of the installed systems. Ventilation rates are used for sizing ventilation systems, 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 avoid possible negative effect of indoor environment and to give advice in respect of improvement of the energy efficiency of existing buildings as well as of the heating and cooling of buildings.

This Technical Report explains how values for the indoor environment (temperature, ventilation, lighting) are used as input to the calculation of the energy demand (building energy demand). Output from measured indoor environmental parameters in existing buildings (temperature, CO₂, ventilation rates, illumination levels) will enable the evaluation of overall annual performance and can be used to display the indoor environmental factors together with data for the energy performance.

Output from room temperature calculations and yearly dynamic building simulations will enable evaluation of the annual performance of buildings at the design stage.

The Technical Report describes methods for measurement of the indoor environment and for treating measured data related to the inspection of HVAC systems.

The Technical Report will provide a method for categorization of indoor environment (Clause 10). This method can be used to integrate complex indoor environment information to simple classification for a possible indoor environment certificate.

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6 How to establish design input criteria for dimensioning of buildings, heating, cooling, ventilation and lighting systems

6.1 Introduction

Recommended input values are given for each of the different categories as shown in Table 3. These categories can be used in different ways. First and foremost they can be used to establish different levels of criteria for the design of buildings and building services. Different countries can standardize one category for design. The consultant and client of a building project can use the categories to agree on a specific design level. The intention is not that a building should be operated strictly in one class the whole year round. Instead the categories can be used to describe the yearly indoor environmental performance of a building by showing the distribution of the parameters in the different categories. It can then, on the national level or in a design/operation contract, be specified how much of the time the categories can be exceeded. This is shown in this report with some examples.