# SLOVENSKI STANDARD
# oSIST prEN 16798-5-1:2015

**01-julij-2015**

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**Energetska učinkovitost stavb - Moduli M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 - Prezračevanje stavb - Računske metode za energetske zahteve sistemov za prezračevanje in klimatizacijo - 5-1. del: Distribucija in proizvodnja (revizija EN 15241) - Metoda 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 (revision of EN 15241) - Method 1

Energieeffizienz von Gebäuden - Module M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 - Lüftung von Gebäuden - Berechnungsmethoden für den Energiebedarf von Lüftungs- und Klimaanlagen - Teil 5-1: Verteilung und Erzeugung (Revision von EN 15241) - Methode 1

Performance énergétique des bâtiments - Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 - Ventilation des bâtiments - Méthodes de calcul pour les besoins énergétiques des systèmes de ventilation et de conditionnement d'air - Partie 5-1 : Distribution et génération (révision de l'EN 15241) - Méthode 1

**Ta slovenski standard je istoveten z:** **prEN 16798-5-1**

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**ICS:**

| | | |
|---|---|---|
| 91.120.10 | Toplotna izolacija stavb | Thermal insulation |
| 91.140.30 | Prezračevalni in klimatski sistemi | Ventilation and air-conditioning |

**oSIST prEN 16798-5-1:2015** **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

**DRAFT**
**prEN 16798-5-1**

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ICS 91.120.10; 91.140.30

Will supersede EN 15241:2007

English Version

# 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 (revision of EN 15241) - method 1

Energieeffizienz von Gebäuden - Teil 5: Lüftung von Gebäuden - Module M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 - Berechnungsmethoden für energetische Anforderungen von Lüftungs- und Klimaanlagen



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

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

# Contents

Page

# Foreword

This document (prEN 16798-5-1:2015) 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, along with prEN 16798-5-2:2014, will supersede EN 15241:2007.

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

EN 16798 currently comprises the following parts:

— prEN 16798-3, *Energy performance of buildings — Part 3: Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems*;

— prEN 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 (revision of EN 15241) — method 1* [the present document];

— prEN 16798-5-2, *Energy performance of buildings — Modules M5-6, M5-8 — Ventilation for buildings — Calculation methods for energy requirements of ventilation systems — Part 5-2: Distribution and generation (revision of EN 15241) — method 2*;

— prEN 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*;

— prEN 16798-9, *Energy performance of buildings — Part 9: Ventilation for buildings — Module M4-1 — Calculation methods for energy requirements of cooling systems — General*;

— prEN 16798-11, *Energy performance of buildings — Module M4-3 — Calculation of the design cooling load*;

— prEN 16798-13, *Energy performance of buildings — Part 13: Module M4-8 — Calculation of cooling systems - Generation*;

— prEN 16798-15, *Energy performance of buildings — Part 15: Module M4-7 — Calculation of cooling systems — Storage — General*;

— prEN 16798-17, *Energy performance of buildings — Part 17: Ventilation for buildings — Module M4-11, M5-11, M6-11, M7-11 — Guidelines for inspection of ventilation and air conditioning systems*;

— prEN 16798-11, *Energy performance of buildings — Module M4-3 — Calculation of the design cooling load*.

This standard replaces EN 15241, which was developed during the first EPBD mandate and was published in 2007.

The revision for inclusion in the second mandate package was performed by CEN/TC 156/WG 21.

The revision includes changes:

— for a rearrangement of content versus EN 15242:2007, in order to better fit in the modular structure given in prEN 15603:2013;

— to cover full air conditioning systems (including heating, cooling humidification, dehumidification; definition see EN 13779, module M5-1);

— for an improved fan energy calculation, taking into consideration control strategies according to CEN/TC 247 and fan product standards /data;

— for an improved calculation of different types of heat recovery devices (air-to-air HX, rotary and pumped circuit), delivering the efficiency and auxiliary energy depending on control, including moisture transfer;

— for the consideration of recirculation, including control;

— for an improved humidification calculation for different humidifier types, including auxiliary energy;

— for the calculation of adiabatic cooling;

— the formatting according to the new rules set in CEN/TS 16629;

— the consideration of ISO/TC 205 work performed in the meantime.

Due to the fact that the scope is not identical, a separate document prEN 16798-5-2 was prepared for a second method B, covering compact ventilation systems including heat / DHW generation with a monthly / seasonal calculation method.

# Introduction

This draft Standard is part of a series of standards aiming at international harmonization of the methodology for the assessment of the energy performance of buildings, called “EPB set of standards”.

As part of the “EPB set of standards” it complies with the requirements for the set of basic EPB documents (EN 15603 (see Clause 2), CEN/TS 16628 and CEN/TS 16629 (see Bibliography [2] and [3])) developed under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480, [4]), and supports essential requirements of EU Directive 2010/31/EU on the energy performance of buildings (EPBD).

Where appropriate, the method(s) in each of the EPB standards may provide simplified procedures and/or default values as alternative options.

— Without further specification, these simplified procedures and/or default values may be used without restricting criteria.

NOTE For instance because these are conservative procedures or values.

The term 'default values' should not be confused with 'informative values'. If the values are given in the normative part of the standard, they are normative values. See also next options.

— In other cases, these simplified procedures and/or default values may be intended to be used only for situations where there is limited information. This may be the case in existing buildings with limited possibilities to acquire all input data. In particular when the EPB set of standards is used in the context of national or regional building regulations, specific criteria when the simplified method and/or default data are allowed, may be given at national or regional level, following the template in Annex A. Annex B provides (informative) default choices.



CEN/TC 156 deals with ventilation and air conditioning systems in buildings. Subjects covered by CEN/TC 156 are:



1) energy performance calculation for ventilation, air conditioning and cooling systems;

2) inspection of ventilation and air conditioning systems;

3) installation and commissioning of ventilation and air conditioning systems.

# 1 Scope

Table 1 shows the relative position of this standard within the EN EPB set of standards.

**Table 1 — Position of this standard within the EN EPB set of standards**

| Overarching | | Building (as such) | | Technical Building Systems | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Descriptions | | Descriptions | | Descriptions | Heating | Cooling | Ventilation | Humidification | Dehumidification | Domestic Hot water | Lighting | Building automation and control | PV, wind, .. |
| sub1 | M1 | sub1 | M2 | sub1 | | 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 and control | | | | | | | | | |
| 6 | Building Occupancy and Operating Conditions | 6 | Heat Transfer by Infiltration and Ventilation | 6 | Distribution and control | | | | | | | | | |
| 7 | Aggregation of Energy Services and Energy Carriers | 7 | Internal Heat Gains | 7 | Storage and control | | | | | | | | | |
| 8 | Building Partitioning | 8 | Solar Heat Gains | 8 | Generation and 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 Performanc | | | | | | | | | |

| Overarching | | Building (as such) | | Technical Building Systems | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Descriptions | | Descriptions | | Descriptions | Heating | Cooling | Ventilation | Humidification | Dehumidification | Domestic Hot water | Lighting | Building automation and control | PV, wind, .. |
| sub1 | M1 | sub1 | M2 | sub1 | | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 |
| | | | | | e | | | | | | | | | |
| 11 | Inspection | 11 | Inspection | 11 | Inspection | | | | | | | | | |
| 12 | Ways to Express Indoor Comfort | | | 12 | BMS | | | | | | | | | |
| 13 | External Environment Conditions | | | | | | | | | | | | | |
| 14 | Economic Calculation | | | | | | | | | | | | | |



This draft standard covers energy performance calculation of mechanical ventilation and air conditioning systems. It takes into account the generation (air handling unit) and distribution (duct system) parts. It does not cover the emission part (calculation of the required volume flow rates and/or supply air conditions), which is covered in prEN 16798-7 (revised EN 15242). A calculation method for compact ventilation systems with integrated heating/cooling generation, using a monthly or seasonal calculation time step, is provided in a separate standard prEN 16798-5-2.



## 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 1507, *Ventilation for buildings — Sheet metal air ducts with rectangular section — Requirements for strength and leakage*

EN 1886, *Ventilation for buildings — Air handling units — Mechanical performance*

EN 12237, *Ventilation for buildings — Ductwork — Strength and leakage of circular sheet metal ducts*

EN 12792:2003, *Ventilation for buildings — Symbols, units and terminology*

EN 13053, *Ventilation for buildings — Air handling units — Rating and performance for units, components and sections*

EN 14239 *Ventilation for buildings — Ductwork — Measurement of ductwork surface area*

prEN 15603:2013, *Energy performance of buildings — Overarching standard EPB*

prEN 16798-3:2014, *Energy performance of buildings — Part 3: Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems*

EN ISO 5801, *Industrial fans — Performance testing using standardized airways (ISO 5801)*

EN ISO 7345:1995, *Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, prEN 15603:2013, EN 12792:2003 and prEN 16798-3:2014, and the following apply.

**3.1.1**
**duct heat losses**
heat losses (by leakage and heat transfer) of the ductwork

**3.1.2**
**duct leakage volume flow extracted from a ventilation zone i**
leakage air to the extract air ducts extracted from a ventilation zone

**3.1.3**
**duct leakage volume flow going to a ventilation zone i**
the leakage air from the supply air ducts going to a ventilation zone

**3.1.4**
**extract volume flow from a ventilation zone i**
extract air flow rate extracted from a ventilation zone



**3.1.5**
**heat losses of the AHU**
heat losses (by leakage and heat transfer) of the air handling unit



**3.1.6**
**heat transferred by ground preheating/cooling**
heat transferred to the outside air by ground preheating and cooling

**3.1.7**
**heat transferred by recirculation**
heat transferred to the outside air by recirculation of extract air

**3.1.8**
**heat transferred by heat recovery**
heat transferred to the outside air by heat recovery from extract air

**3.1.9**
**humidification auxiliary energy**
auxiliary energy needed for humidification (for pumps etc.)

**3.1.10**
**humidification generation input**
energy of carrier cr required by the humidifier (for steam humidifiers)

**3.1.11**
**recoverable AHU heat Losses**
heat losses (by leakage and heat transfer) of the air handling unit, recoverable for heating and cooling (negative values)

**3.1.12**
**recoverable duct heat losses**
heat losses (by leakage and heat transfer) of the ductwork, recoverable for heating and cooling (negative values)

**3.1.13**
**required AHU cooling coil output**
heat required to be extracted from air handling unit for cooling and dehumidification of the supply air to the setpoints

**3.1.14**
**required AHU heating coil input**
heat required to be supplied to the air handling unit for heating the supply air to the setpoint

**3.1.15**
**required cooling coil water inlet temperature**
cooling coil water inlet temperature required for cooling and dehumidification of the supply air to the setpoints

**3.1.16**
**required heating coil water inlet temperature**
heating coil water inlet temperature required to heat the supply air to the setpoint

**3.1.17**
**required supply air moisture content**
moisture content of the supply air leaving the air distribution the supply air to the setpoints



**3.1.18**
**supply outside air fraction**
fraction of outside air in the supply air



**3.1.19**
**supply volume flow rate going to ventilation zone i**
supply air flow rate going to a ventilation zone

**3.1.20**
**ventilation auxiliary energy**
auxiliary energy for the service of ventilation (for heat recovery drives, electrical preheating and for control)

## 4 Symbols and abbreviations

### 4.1 Symbols

For the purposes of this Standard, the symbols given in prEN 15603:2013, EN 12792:2003 and the specific symbols listed in Table 2 apply.

**Table 2 — Symbols and units**

| Symbol | Name of quantity | Unit |
|---|---|---|
| *e* | Exponent | - |
| *n* | Rotation number | $min^{-1}$ |
| *R* | Flow resistance | kg / $m^7$ |
| *r* | Evaporation heat of the water | kWh/kg |
| *v* | Velocity | m/s |
| *x* | Moisture content | kg / kg dry air |
| *ε* | Heat recovery efficiency | - |

## 4.2 Subscripts

For the purposes of this draft European Standard, the subscripts given in prEN 15603:2013, and the specific subscripts listed in Table 3 apply.

**Table 3 —Subscripts**

| | | | | | |
|---|---|---|---|---|---|
| EHA | Exhaust air | Coil | Coil | nom | nominal |
| ETA | Extract air | Cnd | Conditioned | req | required |
| IDA | Indoor air | Ctrl | Control | rot | Rotation |
| ODA | Outdoor air | Des | Design | st1..stn | Stage 1 to stage n |
| RCA | Recirculation air | Du | Duct | sur | surrounding |
| SUP | Supply air | hr | heat recovery | xr | humidity recovery |
| a | Air | lea | Leakage | zt | Thermal zone |
| ahu | Air handling unit | nc | non-conditioned | zv | Ventilation zone |



# 5 Description of the method — Output of the method

The method covers the calculation of:

— the volume flow rates provided to the ventilation zones served by the system, based on the required values;

— the supply air temperature and moisture content, based on the required values;

— the ventilation generation input (electric energy required by fans);

— the humidification generation input;

— heating (incl. humidification in case of reheat with adiabatic humidification) and cooling input to the air handling unit (to be transferred to the connected heating and cooling distribution systems calculation);

— the recoverable heat or cold losses from ventilation/air conditioning system for heating or cooling.

— the ventilation auxiliary energy (electric energy for drives of e.g. rotary or pumped circuit heat recovery devices, control devices, actuators….);

— the electric energy required for humidification (only for specific humidifier types);

— the humidification auxiliary energy.

The time step of the output can be:

a) hourly;

b) bin;

according to the application of the standard and time-step of the input.

# 6 Method

## 6.1 Output data

The output data of this method are listed in Table 4.

**Table 4 — Output data of this method**

| Name | Symbol | Unit | Range | Intended destination | Varying |
|---|---|---|---|---|---|
| Ventilation generation input | $E_{V;gen;in;el}$ | kWh | 0...∞ | M1–9, M5–4 | Yes |
| Humidification generation input | $E_{HU;cr}$ | kWh | 0...∞ | M1–9, M5–4 | Yes |
| Ventilation auxiliary energy | $W_{V;aux}$ | kWh | 0...∞ | M1–9, M5–4 | Yes |
| Humidification auxiliary energy | $W_{HU;aux}$ | kWh | 0...∞ | M1–9, M5–4 | Yes |
| Recoverable duct heat losses | $Q_{V;ls;dis;rbl;zt;i}$ | kWh | -∞...∞ | M2–2 | Yes |
| Recoverable AHU heat losses | $Q_{V;ls;gen;rbl}$ | kWh | -∞...∞ | M2–2 | Yes |
| Required AHU heating coil input | $Q_{H;ahu;in;req}$ | kWh | 0...∞ | M3–1 | Yes |
| Required AHU cooling coil output | $Q_{C;ahu;out;req}$ | kWh | 0...∞ | M4–1 | Yes |
| Heat transferred by heat recovery | $Q_{hr}$ | kWh | -∞...∞ | M5–4 | Yes |
| Heat required for the supply air without heat recovery | $Q_{H;ahu;in;tot;req}$ | kWh | 0...∞ | M5–4 | Yes |
| Electric energy input for the pressure drop of the heat recovery | $E_{V;gen;in;el;hr}$ | kWh | 0...∞ | M5–4 | Yes |
| Required heating coil water inlet temperature | $\vartheta_{H;ahu;in;req}$ | °C | 20…90 | M3–1 | Yes |
| Required cooling coil water inlet temperature | $\vartheta_{C;ahu;in;req}$ | °C | 0…20 | M4–1 | Yes |
| Supply volume flow rate going to ventilation zone i | $q_{V;SUP;dis;zv;i}$ | $m^3/h$ | 0...∞ | M5–5 | Yes |
| Extract volume flow from a ventilation zone i | $q_{V;ETA;dis;zv;i}$ | $m^3/h$ | 0...∞ | M5–5 | Yes |
| Duct leakage volume flow going to a ventilation zone i | $q_{V;lea;SUP;dis;zv;i}$ | $m^3/s$ | 0...∞ | M5–5 | Yes |
| Duct leakage volume flow extracted from a ventilation zone i | $q_{V;lea;ETA;dis;zv;i}$ | $m^3/s$ | 0...∞ | M5–5 | Yes |
| Supply outside air fraction | $f_{ODA}$ | - | 0…1 | M5–5 | Yes |
| Supply air temperature | $\vartheta_{SUP;dis;out}$ | °C | −273...∞ | M5–5 | Yes |
| Supply air moisture content | $x_{SUP;dis;out}$ | kg/kg dry air | 0...∞ | M5–5 | Yes |



$E_{V;gen;in;el}$ is the electric energy required by the fan(s);

$E_{HU;\ cr}$ is the energy of carrier cr required by the humidifier;

$W_{V;aux}$ is the auxiliary energy for the service of ventilation (for heat recovery drives, electrical preheating and control);

$W_{HU}$ is the auxiliary energy for humidification (for pumps, etc.);

$Q_{V;ls;dis;rbl;zt;i}$ is the heat losses (by leakage and heat transfer) of the ductwork, recoverable for heating and cooling (negative values);