SLOVENSKI STANDARD
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Energijske lastnosti stavb - Metoda za izračun energijskih zahtev in učinkovitosti sistema - 6-5. del: Razlaga in utemeljitev EN 15316-4-2 - Modul M3-8

Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-5: Explanation and justification of EN 15316-4-2, Module M3-8

Heizungsanlagen und Wasserbasierte Kühlanlagen in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 6-5: Begleitende TR zur EN 15316-4-2 (Wärmeerzeugung für die Raumheizung, Wärmepumpensysteme)

Performance énergétique des bâtiments - Méthode de calcul des besoins énergétiques et des rendements des systèmes - Partie 6-5: Explication et justification de l'EN 15316-4-2, Module M3-8

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European foreword

This document (CEN/TR 15316-6-5:2017) has been prepared by Technical Committee CEN/TC 228 “Heating systems and water based cooling systems in buildings”, the secretariat of which is held by DIN.

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Introduction

The set of EPB standards, technical reports and supporting tools

In order to facilitate the necessary overall consistency and coherence, in terminology, approach, input/output relations and formats, for the whole set of EPB-standards, the following documents and tools are available:

a) a document with basic principles to be followed in drafting EPB-standards: CEN/TS 16628:2014, *Energy Performance of Buildings - Basic Principles for the set of EPB standards* [2];

b) a document with detailed technical rules to be followed in drafting EPB-standards; CEN/TS 16629:2014, *Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards* [3];

c) the detailed technical rules are the basis for the following tools:

   1) a common template for each EPB-standard, including specific drafting instructions for the relevant clauses;

   2) a common template for each technical report that accompanies an EPB standard or a cluster of EPB standards, including specific drafting instructions for the relevant clauses;

   3) a common template for the spreadsheet that accompanies each EPB standard, to demonstrate the correctness of the EPB calculation procedures.

Each EPB-standards follows the basic principles and the detailed technical rules and relates to the overarching EPB-standard, EN ISO 52000-1 [4].

One of the main purposes of the revision of the EPB-standards is to enable that laws and regulations directly refer to the EPB-standards and make compliance with them compulsory. This requires that the set of EPB-standards consists of a systematic, clear, comprehensive and unambiguous set of energy performance procedures. The number of options provided is kept as low as possible, taking into account national and regional differences in climate, culture and building tradition, policy and legal frameworks (subsidiarity principle). For each option, an informative default option is provided (Annex B).

Rationale behind the EPB technical reports

There is a risk that the purpose and limitations of the EPB standards will be misunderstood, unless the background and context to their contents – and the thinking behind them – is explained in some detail to readers of the standards. Consequently, various types of informative contents are recorded and made available for users to properly understand, apply and nationally or regionally implement the EPB standards.

If this explanation would have been attempted in the standards themselves, the result is likely to be confusing and cumbersome, especially if the standards are implemented or referenced in national or regional building codes.

Therefore each EPB standard is accompanied by an informative technical report, like this one, where all informative content is collected, to ensure a clear separation between normative and informative contents (see CEN/TS 16629 [3]):

— to avoid flooding and confusing the actual normative part with informative content,

— to reduce the page count of the actual standard, and

— to facilitate understanding of the set of EPB standards.

This was also one of the main recommendations from the European CENSE project [5] that laid the foundation for the preparation of the set of EPB standards.

1 Scope

This Technical Report refers to EN 15316-4-2, covering module M3-8.

It contains information to support the correct understanding, use and national adaptation of EN 15316-4-2.

This Technical Report does not contain any normative provision.

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 15316-4-2:2017, *Energy performance of buildings — Method for calculation of system energy requirements and system efficiencies — Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2*

EN 15603, *Energy performance of buildings — Overall energy use and definition of energy ratings*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345, EN 15603, EN 15316-4-2 and the following apply.

3.1
bivalent temperature
$\boldsymbol{\vartheta_{biv;ref}}$
outdoor temperature **declared** by the supplier for heating at which the declared capacity for heating equals the part load for heating and below which the declared capacity for heating requires supplementary capacity for heating to meet the part load for heating, expressed in degrees Celsius

Note 1 to entry: This definition corresponds to the terms of EN 14825.

Note 2 to entry: In the context of EN 15316-4-2, the bivalent temperature ϑ_{biv} is adapted to the thermal load of the building and is different from the EN 14825 conditions which means:

1) Input data consider temperatures, thermal capacities and COP based on the test conditions identified from EN 14825,

2) This EN 14825 bivalent temperature $\vartheta_{biv;ref}$,COP_{ref} and thermal capacity data is used as part of the EN 14825 dataset to interpolate COP and capacity for each time step (operating condition) (using Path B)

3) EN 15316-4-2 determines a specific bivalent temperature for each time step (operating condition), which is different to the Manufacturer declared value (from EN 14825 data), to determine back-up requirement

4) Practically the bivalent temperature is a fixed value declared in the input data ϑ_{biv} and use for control of the additional heating system when thermal capacity does not fulfill the thermal capacity required.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in EN 15603 and in EN 15316-4-2 apply.

4.2 Subscripts

For the purposes of this document, subscripts given in EN 15603 and in EN 15316-4-2 apply.

5 Information on the method

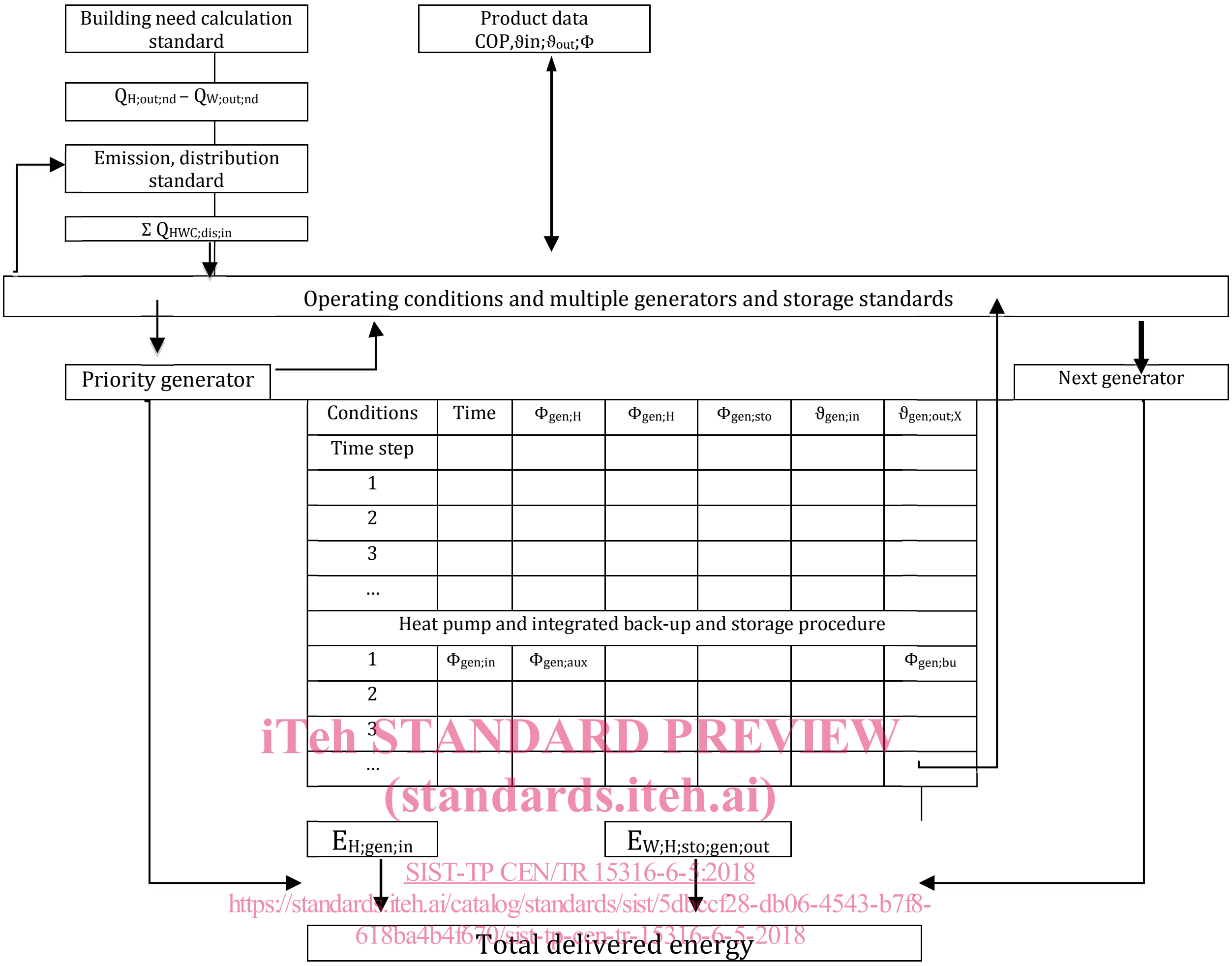
5.1 General

The method calculates the thermal energy provided by heat pump systems for heating of domestic hot water use.

Table 1 explains how the information and output of the calculation are used in such multiple systems.

In this case, the heat pump, including its integrated back-up system (if any) is considered as the priority generator.

Table 1 — Heat pump systems and interaction with other generators



6 Method description

6.1 Rationale

Depending of the input data provided 2 paths can be used for the calculation of the energy performance of the heat pump generation system

Path A is based on a single reference value.

Path B is based on performances of the heat pump according to EN 14825.

Depending on the thermal power and temperature determined form the operating conditions and from the distribution systems, the following values are calculated:

— energy delivered to the heat pump systems;

— COP (coefficient of performance);

— energy for auxiliaries;

— recoverable thermal losses.

The calculation is processed in 2 stages:

— determination of energy used from and delivered to at full load for the non nominal operating conditions;

— determination of energy used from and delivered to the heat pump systems at part load.

A flowchart is given in Annex A.

6.2 Time steps

Time step is typically:

— hourly;

— bin;

— monthly (or annual) based on bin approach.

6.3 Assumptions

The matrix for COP and power of the heat pump at the nominal condition is calculated at the beginning of the calculation. It is assumed that the COP and power vary linearly within the narrowest values of the matrix.

Energy is delivered to the distribution system at the beginning of the step time.

The energy for auxiliaries is considered as proportion of the operative time of the heat pump.

Dynamic effects due to transient thermal conditions are transformed into a time delay depending on the type of emitters and of the temperature to be achieved at the output of the heat pump system.

Heat pump is considered operating at full load for DWH energy use.

6.4 Data input

6.4.1 Energy required

The energy and temperature requirements are issued from EN 15316-3, including thermal gains and impact of the control system on the energy demand.

For annual and monthly method, the default energy demand for heating is based on the design temperature of the building. The impacts of control system (reduced temperature during the night or occupancy) and thermal gains (activity, type of building, solar gains) are introduced as weighting factors. These weighting factors can be supersedes based on national methods, as internal gains are assumed not to be in proportion of the external temperature and impact of the reduced temperature increase with the external temperature.

6.4.2 COP and thermal capacity

Thermal capacity and COP are the declared values by the manufacturer.

Path A is based on a reference value for COP and thermal capacity at full load. Default values are proposed to calculate COP and thermal capacity for any conditions at full load. If available, the user of the method can adapt the default multiplying factors to the performance of the heat pump as for example more than one value are available (e.g. air-to-water heat pump with a lot of values according to EN 14511: -7/35, 2/35, 7/35, -7/55, 7/55).

User should mind that the test values of EN 14511 have not to be and are not at 100 % capacity of inverter-controlled heat pump. That means, mostly the values at -7 °C or -15 °C are at 100 % capacity, but the values at 2 °C, 7 °C or higher may be given at a lower capacity (e.g. 60 %). That means, the usage of these values shall take into consideration a quadruple of values: air temperature, flow temperature, capacity of the heat pump and COP-value.

Correction of temperature spread under operational condition is proposed in Annex D, based on additional information (e.g. an average mass flow and the design condition temperature spread). If this information is not available the correction of temperature spread is neglected.

6.4.3 Other parameters and coefficients

— $f_{gen;R;cont;min}$ is introduced as a degradation factor. The factor depends on the temperature output and may vary from 0,7 (65 °C) to 0,95 (30 °C).

$$f_{gen;LR;cont;min} = 0,95 - 0,25 \times \left(\frac{\vartheta_{h;gen;out} - 30}{65 - 30} \right) \text{ [-]} \tag{1}$$

NOTE The influence is low as this factor only influences the energy calculation when the load ratio is lower than a determined value $LR_{cont;min}$. Global impact of energy used by the heat pump system is less than 1 % on the annual amount of energy used by the heat pump.

— $f_{gen;ctrl}$ is a factor accounting for the reduced mode of the room temperature during unoccupancy or night (for residential is the function is activated)

— $\tau_{out,em,type}$ is a factor depending of the type of emitters at the output of the heat pump systems. The factor is related to the inertia of the installation. In the case of an external buffer storage, the value of the factor used for high inertia emitters can be considered if not accounted in the model of the storage unit

6.5 Calculation methods

6.5.1 Calculation of COP and thermal capacity based on EN 14511 — Path A

6.5.1.1 General

Correction of temperature spread under operational condition is proposed in Annex D, based on addtionnal information (e.g. an average mass flow and the design condition temperature spread). If this information is not available the correction of temperature spread is neglected

6.5.1.2 Correction of COP for part load operation – Path A

The advantages of controllable heat pumps are taken into account if test values of the controllable heat pump at maximum and minimum capacity are available.

The maximum and minimum capacity curves are valid at each flow temperature (e.g. 35 °C or 45 °C or 55 °C or 65 °C – according to EN 14511) and regard the dependency of the COP-value on source temperature (air) and capacity of the heat pump (relative and absolute capacity).

The maximum curve is yielded when a linear interpolation and extrapolation is carried out with the test values at maximum capacity at one flow temperature. Figure 1 shows a possible maximum capacity curve at one flow temperature in dependency on external temperature (key 4).The minimum capacity curve (key 3 and 4) can be obtained in dependency on available test values: method A-1 (only 1 value of minimum curve is available) and method A-2 (more than 1 value of minimum curve is available).