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Energy performance of buildings - Method for calculation of system energy performance and system efficiencies - Part 6-6: Explanation and justification of EN 15316-4-3, Module M3-8-3, M8-8-3

Heizungsanlagen und Wasserbasierte Kühlanlagen in Gebäuden - Verfahren zur Berechnung der Energieanforderungen und Nutzungsgrade der Anlagen - Teil 6-6: Begleitende TR zur EN 15316-4-3 (Wärmeerzeugungssysteme, thermische Solar- und Photovoltaikanlagen)

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

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European foreword

This document (CEN/TR 15316-6-6:2017) 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 [1];

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 [2];

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 [17].

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 [2]):

— 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 [19] that laid the foundation for the preparation of the set of EPB standards.

1 Scope

This Technical Report refers to EN 15316-4-3, Modules 3-8 and 8-8.

It contains information to support the correct understanding, use and national adaptation of EN 15316-4-3.

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 15316-4-3:2017, *Energy performance of buildings — Method for calculation of system energy requirements and system efficiencies — Part 4-3: Heat generation systems, thermal solar and photovoltaic systems, Module M3-8-3, M8-8-3, M11-8-3*

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

EN ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures (ISO 52000-1:2017)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, EN ISO 52000-1:2017, EN 15316-4-3:2017 (the accompanied EPB standard) apply.

4 Symbols and subscripts

For the purposes of this document, the symbols and subscripts given in EN ISO 52000-1:2017 and in EN 15316-4-3:2017 apply.

5 Information on the methods

5.1 General

The standard describes six methods for solar applications for intended use in buildings. The methods one to three refer to solar thermal applications and the methods four to six refer to photovoltaic applications.

5.2 Solar thermal methods

Method 1 is used for solar thermal applications if (only) system test data according to EN 12976-2 is available. This is commonly the case for solar system types for which the component specifications cannot be determined separately. An example of this is a so called Integrated Collector Storage system (= ICS).

The system test result, the annual performance of the system, for the actual climate conditions is interpolated to the actual heat demand. Optionally the annual performance is distributed over the month, using the distribution of the solar irradiance on the collector plane as the key. The method 1 is limited to the generation of heat for the service domestic hot water production.

Method 2 is used for solar thermal applications if component specifications for the collector and heat storage are available. This is commonly the case for solar thermal for intended use in buildings. Examples of this are solar domestic hot water systems and combi-systems.

The method 2 applies the so called Fchart method [3] to calculate the monthly performance using the component specifications and system design parameters as input. The method 2 is applicable for the services water heating and space heating. The method 2 is intended for use with a monthly time step.

Method 3 is used for solar thermal applications if component specifications for the collector and heat storage are available. Method 3 applies an hourly numerical calculation method to determine the solar loop output to the storage tank. The method 3 is intended to be used in combination with EN 15316-5. The combination of the two methods is applicable for the services water heating and space heating.

5.3 Photovoltaic applications

6 Method description

6.1 Solar thermal applications

6.1.1 Method 1 – monthly, using system test data

6.1.1.1 General

The effect of a thermal solar system on the energy performance of a building comprises of:

— heat output to the distribution systems for domestic hot water, thus reducing the buildings consumption of other (e.g. conventionally generated) heat;

— recovered losses used for space heating, thus reducing the buildings consumption of heat for space heating;

— electricity to be supplied, thus increasing the buildings consumption of electricity;

— reduction of operation time of the conventional heating generator. In some cases, the conventional back-up heater can be turned off during summer, thus reducing stand-by thermal losses and auxiliary electricity consumption.

6.1.1.2 Rationale

Method 1 uses system test data for the product technical input data. The system test data are derived from a test result according to EN 12976-2 or according to EN 12977-2.

The test method following EN 12976-2 consists of two steps:

1. system test;

   The goal of the system test is to determine the whole system performance parameters determined from dynamic operating conditions.

2. annual performance calculation.

   The performance parameters are combined with a simplified, standardized, calculation model to calculate the performance for (e.g.) one year for specific reference climate and heat use conditions.

   Method 1 requires two sets of the annual performance for the climate conditions applicable. One for a lower or equal and one with a higher heat use than applicable. By means of linear interpolation the annual performance for the applicable heat use is derived from these results.

The test method following EN 12977-2 consists of two steps:

3. component tests;

   The main components of the system are tested according to EN ISO 9806 and EN 12977-3 or EN 12977-4.

4. annual performance calculation.

   The component test results are applied in a simulation calculation model to determine the annual system performance.

In case of a preheater system, the output of the method ($Q_{W;bu;out}$) quantifies the heat output of an external water heater needed to complete the heat use.

In case of a solar-plus-supplementary system, the output of the method ($Q_{W;bu;out}$) quantifies the heat output of an external heater connected to the hot water storage tank to complete the heat use.

A flow chart of the calculation method is given in A.1.

NOTE The method is limited to systems applied for the heating of domestic hot water.

6.1.1.3 Time steps

The time step of the method is one month or one year.

6.1.1.4 Assumptions

The output data over the months of the year are assumed to be distributed proportional with the monthly solar irradiation.

The system test result takes into account all component performances and system design parameters of the tested system. The values of the individual performance determinants are not tested and are as such not available for method 1. For this reason necessary extra performance parameters are estimated based on the primary test results.

— The heat losses of the solar heating designated part of the heat storage tank to determine the recoverable heat losses. Both determinant parameters (storage volume and heat losses) are not known form the test results and need to be estimated.

  The storage tank volume is assumed to be equal to the daily volume of domestic hot water extracted from the storage tank. The calculation assumes a temperature difference between the cold water and hot water of 50 K.

$$V_{sto} = \frac{Q_{W;sol;us}}{t_{ci}} \cdot 413,4 \quad (1)$$

  The storage heat loss coefficient is assumed to be the maximum value within the label class C of the Commission Delegated Regulation (EU) No 812/2013.

$$U_{sto} = \frac{16,66 + 8,33 \cdot V_{sto}^{0,4}}{45} \quad (2)$$

  Simplifying gives:

$$U_{sto} = 0,37 + 2,06 \cdot \left(\frac{Q_{W;sol;us}}{t_{ci}} \right)^{0,4}$$

The heat losses of the storage tank are calculated for a storage temperature of 60 °C and multiplied with the solar fraction ($Q_{W;sol;out}$ / $Q_{W;sol;us}$).

— The heat losses of the backup heating designated part of the heat storage tank to determine the recoverable heat losses.

The main portion of the storage heat losses origin from the backup heating designated part of the storage tank (solar-plus-supplementary systems only). The heat losses are estimated following the same method as for the solar part of the storage, but without multiplying with the solar fraction.

6.1.1.5 Data input

6.1.1.5.1 Product technical data

Be aware that the performances related to heat are defined in MJ. For that reason the outputs of EN 12976-2 need to be transformed to kWh.

Table 1 — Product technical data

Standard		Catalogue			
Symbol	**Unit**	**Symbol**	**Unit**	**Description**	**Remarks**
$W_{W;sol;aux;an}$	kWh	Q_{par}	MJ	auxiliary energy consumption	Test result.
$Q_{W;sol;us;an}$	kWh	Q_{d}	MJ	energy required for service domestic hot water.	Condition for which the test results are valid.
SOL_LAYOUT = SER only:					
$Q_{W;sol;out;an}$	kWh	Q_{L}	MJ	Solar output	Test result.
SOL_LAYOUT = PAR only:					
$Q_{W;bu;an}$	*kWh*	$Q_{aux;net}$	MJ	Backup heater contribution to the heat use	Test result.

6.1.1.5.2 Operational conditions

Table 2 — Operational conditions

Symbol	Unit	Description	Remarks
t_{ci}	h	Calculation time step	February is assumed to have 28 days.
$I_{sol;S45}$	W/m²	Average solar irradiation on the collector plane	
$\vartheta_{outside}$	°C	Average outside air temperature	
$Q_{W;sol;us}$	kWh	Energy required for service domestic hot water	
$W_{W;bu;aux;nom}$	kWh	Auxiliary energy consumption backup-heater	Output of the backup heat generator module
$Q_{W;bu;ls;nom}$	kWh	Heat losses backup heater	Output of the backup heat generator module

NOTE The values of the operating conditions are determined for the considered calculation period.

6.1.1.6 Simplified input

6.1.1.7 Calculation information

6.1.2 Method 2 – monthly, using component specifications

6.1.2.1 General

The effect of a thermal solar system on the energy performance of a building comprises of:

— heat output of the thermal solar system to the distribution systems (for space heating and/or for domestic hot water), thus reducing the buildings consumption of other (e.g. conventionally generated) heat;

— recovered losses from the thermal solar system used for space heating, thus reducing the buildings consumption of heat for space heating;

— electricity to be supplied to the thermal solar system, thus increasing the buildings consumption of electricity;