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**Energijske lastnosti stavb - Sistemi za ogrevanje stavb in pripravo tople sanitarne vode - 4. del: Razlaga in utemeljitev EN 15378-3 - Modula M3-10 in M8-10**

Energy performance of buildings - Heating systems and DHW in buildings - Part 4: Explanation and justification of EN 15378-3, Module M3-10, M8-10

Heizungsanlagen und Wasserbasierte Kühlanlagen in Gebäuden - Heizungsanlagen und Trinkwarmwasseranlagen in Gebäuden - Teil 4: Begleitender TR zur EN 15378-3 (Messungen der Energieeffizienz)

Performance énergétique des bâtiments - Performance énergétique mesurée - Partie 4: Explication et justification de l'EN 15378-3, Modules M3-10, M8-10

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**SIST-TP CEN/TR 15378-4:2018** **en**

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## Energy performance of buildings - Heating systems and DHW in buildings - Part 4: Explanation and justification of EN 15378-3, Module M3-10, M8-10

Performance énergétique des bâtiments - Performance  
énergétique mesurée - Partie 4: Explication et  
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Trinkwarmwasseranlagen in Gebäuden - Teil 4:  
Begleitender TR zur EN 15378-3 (Messungen der  
Energieeffizienz)

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## European foreword

This document (CEN/TR 15378-4:2017) 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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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, *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, *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 a 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 52000-1:2017.

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 high 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 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 [4] that laid the foundation for the preparation of the set of EPB standards.

### **This Technical Report:**

This Technical Report accompanies the standard EN 15378-3:2017 on the assessment of measure measured delivered energy for space heating and domestic hot water preparation.

The first part of this Technical Report, up to Clause 13 and all annexes up to Annex D have the same numbering as EN 15378-3:2017. Each clause in this CEN/TR 15378-4 is related to the same clause in EN 15378-3:2017.

The role and the positioning of the accompanied standard(s) in the set of EPB standards is defined in the Introduction to the standard.

### **Accompanying spreadsheet(s):**

Concerning the accompanied standard EN 15378-3:2017, the following spreadsheets were produced:

- one spreadsheet on space heating measured delivered energy assessment using the seasonal data interpolation method (see 6.8);
- one spreadsheet on space heating measured delivered energy assessment using the energy signature method (see 6.9);
- one spreadsheet on domestic hot water measured delivered energy assessment;
- one spreadsheet on boiler efficiency assessment, both combustion efficiency and seasonal efficiency.

In this Technical Report, two examples of space heating measured delivered energy assessment are included.

### **History of this Technical Report and the accompanied standard:**

EN 15378-3:2017 is the first edition of a standard on measured energy performance. It includes provisions already included in several previous standards like EN 15603:2008 (energy signature method) and EN 15378:2007 (measurement of combustion efficiency and estimation of boiler seasonal efficiency) and others.

This Technical Report has been drafted as part of Mandate 480 of the EC to CEN.

References in the text of the standard are given as module codes that are detailed in the annex. This enables flexible references (e.g. to national documents where necessary for local application) and use outside the CEN environment.

## CEN/TR 15378-4:2017 (E)

## 1 Scope

This Technical Report refers to EN 15378-3:2017, *Energy performance of buildings — Heating and DHW systems in buildings — Part 3: Measured energy performance, Module M3-10, M8-10*.

It contains information to support the correct understanding, use and national adaptation of EN 15378-3:2017.

## 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.

CEN/TR 15378-2:2017, *Energy performance of buildings — Heating systems and DHW in buildings — Part 2: Explanation and justification of EN 15378-1, Module M3-11 and M8-11*

EN 15378-3:2017, *Energy performance of buildings — Heating and DHW systems in buildings — Part 3: Measured energy performance, Module M3-10, M8-10*

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 procedure (ISO 52000-1:2017)*

## 3 Terms and definitions

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For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, EN ISO 52000-1:2017 and EN 15378-3:2017 apply.

NOTE There are no new terms in this Technical Report.

Most terms used in EN 15378-3:2017, such as:

- space heating;
- gross and net calorific value;
- external temperature;
- energy carrier;
- delivered energy;

and others are already defined in EN ISO 52000-1:2017 and are not repeated.

The definitions of assessment period, measurement interval and measurement period have been repeated because they are fundamental for the correct understanding of this standard.

## 4 Symbols, subscripts and abbreviations

### 4.1 Symbols

For the purposes of this Technical Report, the symbols given in EN ISO 52000-1:2017 and EN 15378-3:2017 apply.

There are no new symbols in this Technical Report

### 4.2 Subscripts

For the purposes of this Technical Report, subscripts given in EN ISO 52000-1:2017 and EN 15378-3:2017 (the accompanied EPB standard) apply.

There are no new subscripts in this Technical Report.

### 4.3 Abbreviations

For the purposes of this Technical Report, abbreviations given in EN ISO 52000-1:2017 and EN 15378-3:2017 (the accompanied EPB standard) apply.

There are no new abbreviations in this Technical Report.

## 5 Description of the methods

### 5.1 Available procedures

EN 15378-3 deals with all procedures related to measuring the delivered energy for space heating and domestic hot water preparation.

EN 15378-3 also includes normalization techniques of the measured delivered energy.

EN 15378-3 also includes measurement procedures for specific partial performance indicators of the space heating and domestic hot water technical systems, such as combustion efficiency and boiler seasonal efficiency. Some of the procedures are a mix of simple measurements and quick calculations based on tabulated default values.

### 5.2 Assessment of measured heating and domestic hot water delivered energy

#### 5.2.1 Output of the method

The output of the method is an un-weighted delivered energy amount.

The weighting of the measured delivered energy is described in EN ISO 52000-1:2017, Clause 8.

#### 5.2.2 Optional procedures

This standard about measured energy performance is based on consideration of the following sources:

- Contents of EN 15603:2008;
- Contents of EN 15378:2007;
- Slovak National annex to EN 15603:2008
- Rules for Display Energy Certificates in the United Kingdom;
- Information from Swedish Energy Agency.

## CEN/TR 15378-4:2017 (E)

All measurement procedures have been concentrated in this standard, including procedures for partial performance indicator measurements

The basic procedure given in Clause 6 deals with the overall measured energy performance for heating and domestic hot water. A common procedure is defined for data preparation and validation. Then two alternative methods are given for the standardization of actual measured delivered energy:

- the seasonal data interpolation method is derived from the Slovak National annex to EN 15603:2008. seasonal or quasi-seasonal data are corrected according to internal temperature and then extrapolated to the standard external temperature (6.8);
- the energy signature method is derived from a method given in EN 15603:2008 and proposed as an alternative (6.9).

Plain reporting is also described.

### 5.2.3 Validation of measured rating

Despite trying to give clear rules, the uncertainty about the validity of collected data and on internal conditions of use of the building during the measurement period is still a critical aspect. This can be effectively solved only if measurements and required instruments and sensors are fully part of the design, installation and operation of the building.

### 5.2.4 Correction according to standard use and/or climate

When using the measured energy performance for certification or regulatory purpose, it is necessary to correct the actual measured delivered energy to standardized indoor (use) and outdoor (climatic) conditions.

The types of EPB assessment types defined in EN ISO 52000-1 for measured energy performance are repeated in Table 1 for easier understanding.

**Table 1 — Types of measured energy performance assessments in EN ISO 52000-1:2017**

Type	Subtype	Input data			Type of application
		Use	Climate	Building	
<b>Calculated</b>	...	...	...	...	...
<b>Measured (operational)</b>	Actual	Actual	Actual	Actual,	Monitoring
	Climate corrected	Actual	Corrected to standard	Actual	Monitoring, or energy audit
	Use corrected	Corrected to standard	Actual	Actual	Monitoring
	Standard	Corrected to standard	Corrected to standard	Actual	Energy performance certificate, regulation

The correction of measured delivered energy according to internal and/or external conditions depending on the desired type of assessment is performed in EN 15378-3:2017.

Use of the measured delivered energy to determine the standardized energy performance is not appropriate for all buildings. It is best suitable for buildings that meet the following conditions:

- the energy for heating can be individually metered at the building boundary or enough data are available to separate energy dedicated to any other service.
- the period covered by measurement is long enough;

- the internal conditions of use of the building are well known.

NOTE The uncertainty of measurement will be higher when extrapolating to normalized conditions measurements of heat (energy) use for a short time period of measurement. Interpolation is more reliable but requires a long data history (measurement period).

- heating system losses are not excessive;
- heat gain/loss ratio of is not too large, so that fluctuations of solar heat gains have not a big impact on overall energy use and the impact of fluctuations of solar heat gains can be offset by a longer measurement period;
- in the building, there are more independent users and non-standard behaviour of the individual user does not have a big impact on the overall energy use.

Risks of using the measured delivered energy for heating to predict energy needs for normalized conditions are:

- insufficient quality and reliability of the measured delivered energy data;
- influence of the current occupants of a building on the measured heat use.

### 5.3 Assessment of measured boiler combustion efficiency

Clause 7 deals with the assessment of combustion efficiency of combustion devices. It is a basic check of the correct burner setting and provides a basic information about instantaneous efficiency. This is supported by dedicated measuring instruments that are already standardized. This measurement is often used as a basic step of more detailed assessments.

The proposed method includes also a calculation method of latent heat recovery for condensing boilers. It is the same that was included in EN 15316-4-1:2008.

### 5.4 Assessment of boiler seasonal efficiency

Clause 8 deals with boiler seasonal efficiency estimation.

It is based on a mixture of simple measurements and tabulated losses coefficients.

The method also provides an estimation of the seasonal boiler load factor, that is in relation with the boiler sizing compared to the actual needs.

The method provides a thermal seasonal efficiency. Auxiliaries are not taken into account (they may only have a theoretical influence on combustion efficiency).

### 5.5 Domestic hot water system efficiency

Clause 9 deals with seasonal domestic hot water production efficiency assessment.

Clause 7 only allows to determine the delivered energy for domestic hot water preparation, without knowing the actual volume of domestic hot water used.

This clause also considers the actual volume of domestic hot water used and therefore can be applied only if a domestic hot water meter volume is available (and was read at due time).

### 5.6 Other measurement methods

Some additional measurement methods, such as heat pump COP measurement, are briefly introduced.

However these methods are not yet developed and experimented, therefore only some general principles are given.

## 6 Measured delivered energy for heating and domestic hot water

### 6.1 Rationale and output data

This method is intended for an existing building, during the operation phase.

The actual delivered energy is assessed first, by energy carrier. Auxiliary energy is estimated if no meter is available.

Assessment of delivered energy carriers is developed in the form of a table to have a traceable source of data.

The basic procedure assumes that a flow of delivered energy is measured first, then the uses are separated by measurement or simple statistical techniques.

At first all the non-heating (e.g. not for space heating) delivered energy is separated.

If a standardized operational rating is desired, then the measured energy for space heating is adjusted according to actual building conditions of use and of actual climatic conditions, thus providing the “standard measured energy. The correction is performed according to conditions of use using:

- available knowledge of average internal temperature;
- linear regressions on external temperature or degree days.

The main assumption is that the difference between internal and external temperature is the main driving variable.

Then the domestic hot water energy use may be extracted from the non-heating energy.

- If no measurement of the actual volume of produced domestic hot water is available, then no further elaboration is possible.
- If a measurement of the actual volume of produced domestic hot water is available, then a correlation between the produced domestic hot water and the used power allows to normalize the delivered energy for domestic hot water preparation.

When providing an operational rating one shall be very clear about which corrections have been performed depending on weather, occupancy, indoor comfort that deviate from the standard assumptions for a calculated energy rating. Performing (or skipping entirely or partially) this step depends on the objective of the calculation.

- It is usually required for a standardized operational rating that shall be used:
  - as a standardized rating;
  - or to validate a calculated result with the actual energy use to obtain a higher confidence level in the calculation model and input data used for calculations.
- It may be not required for the planning and follow up of energy saving measures as well as for comparison with an appropriate tailored rating (energy auditing domain).

When extrapolating or interpolating values the following main assumptions are made:

- transmission and ventilation losses vary linearly with degree-days;
- other services and uses than space heating, unless otherwise stated or measured, are considered as being constant power.

A reliable operational rating requires consistent, accurate and timely measurements. This implies that appropriate instruments are designed and in place and that reading and recording procedures are followed. An operational rating attempt on a system that was not designed or upgraded to support operational rating will seldom meet the quality requirements for the validity of the standardized operational rating.

EXAMPLE 1 The reading of the gas meter happens seldom at the exact beginning and end of the heating season

EXAMPLE 2 A general domestic hot water counter is seldom available on individual heating systems

EXAMPLE 3 A heat meter on the connection between the boiler and the domestic hot water production device is seldom available in centralized heating systems.

When applying retrofitting measures on an existing building, the existence of sufficient instrumentation and procedures for follow-up should be assessed.

NOTE EN 16247-1 states that any suggested energy conservation measure shall include a verification method.

The output data are the type and amount of each delivered energy carrier. The weighting and conversion into primary energy or CO<sub>2</sub> emission is covered in EN ISO 52000-1:2017.

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