

ICS 91.120.10; 91.140.10; 91.140.65

English Version

**Energy performance of buildings - Method for calculation  
of system energy requirements and system efficiencies -  
Part 6-4: Explanation and justification of EN 15316-4-1,  
Module M3-8-1, M8-8-1**

Performance énergétique des bâtiments - Méthode de  
calcul des besoins énergétiques et des rendements des  
systèmes - Partie 6-4 : Explication et justification de  
l'EN 15316-4-1, Module M3-8-1, M8-8-1

Heizungsanlagen und Wasserbasierte Kühlanlagen in  
Gebäuden - Verfahren zur Berechnung der  
Energieanforderungen und Nutzungsgrade der  
Anlagen - Teil 6-4: Begleitender TR zur EN 15316-4-1  
(Wärmeerzeugung für die Raumheizung und  
Trinkwarmwasser, Verbrennungssysteme  
(Heizungskessel, Biomasse))

This Technical Report was approved by CEN on 27 February 2017. It has been drawn up by the Technical Committee CEN/TC 228.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

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

Contents	Page
European foreword.....	4
Introduction.....	5
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions.....	7
3.1 Terms.....	7
3.2 Symbols.....	7
3.3 Abbreviations and indices.....	7
4 Description of the method.....	7
4.1 Output of the method.....	7
4.1.1 Description.....	7
4.1.2 Example.....	8
4.2 General description of the method.....	9
4.3 Input data.....	9
4.3.1 Description.....	9
4.3.2 Example.....	13
4.4 Boundaries between distribution and generation sub-system.....	13
4.5 Default values.....	15
4.5.1 Default values for generator efficiency at full load and intermediate load as a function of the generator power output.....	15
4.5.2 Default value for the stand-by heat losses $f_{\text{gen;ls;P0}}$ as a function of the generator power output.....	16
4.5.3 Auxiliary energy.....	16
4.6 Product values.....	17
4.7 Measured values.....	17
4.7.1 Boiler efficiencies from measured values.....	17
4.7.2 Measured total thermal losses, power input and calculated gains.....	18
4.7.3 Additional default data and calculation for condensing boilers.....	18
4.7.4 Thermal losses through the chimney with the burner on at full load $f_{\text{ch;on}}$ .....	20
4.7.5 Thermal losses through the generator envelope $f_{\text{gen;env}}$ .....	20
4.7.6 Thermal losses through the chimney with the burner off $f_{\text{ch;off}}$ .....	21
4.8 Boiler rated output.....	21
5 Generation sub-system basic energy balance.....	21
5.1 Heat balance.....	21
5.2 Expenditure factor.....	22
5.3 Fuel heat input.....	23
5.3.1 Description.....	23
5.3.2 Example.....	23
5.4 Generator auxiliary energy.....	24
5.4.1 Description.....	24
5.4.2 Example.....	24
5.5 Generator losses.....	24
5.5.1 Generator loss.....	24
5.5.2 Generator thermal loss at specific load ratio $\beta_{\text{H;gen}}$ and power output $PP_x$ .....	24
5.5.3 Generator thermal loss calculation at full load.....	25

5.5.4	Generator thermal loss calculation at intermediate load.....	27
5.5.5	Generator thermal loss calculation at 0 % load .....	28
5.5.6	Correction factor by additional tests.....	29
5.6	Recoverable thermal losses .....	29
5.6.1	general.....	29
5.6.2	Generator thermal losses through the jacket (generator envelope) .....	30
5.6.3	Recoverable thermal losses out of auxiliary energy .....	30
5.7	Recovered auxiliary energy .....	31
5.7.1	Description.....	31
5.7.2	Example.....	31
5.8	Auxiliary energy.....	32
5.8.1	Description.....	32
5.8.2	Example.....	32
5.9	Generator thermal output .....	33
5.10	Heating time and load factor .....	33
5.11	Direct heated DHW heaters .....	34
5.11.1	Instantaneous electrical water heater.....	34
5.11.2	Instantaneous gas water heater .....	34
5.11.3	Gas-fired domestic storage water heaters.....	34
5.12	Method for domestic hot water appliance, tested with 24 hours tapping cycles.....	37
Annex A	(informative) Additional formulas and default values for parametering the boiler efficiency method .....	39
A.1	Information on the method.....	39
A.2	Conversion of the energy content of energy carriers .....	45
A.3	Deviation from default values.....	45
A.4	Fuel constants for flue gas measurement depending on Siegert constants .....	45
A.5	Default values for calculation of thermal losses through the chimney with the burner off.....	47
A.6	Additional default data and calculation for condensing boilers .....	48
A.7	Additional default data for generator output and losses.....	49
A.8	Additional default data and calculation for water heaters.....	49
Annex B	(informative) Additional formulas and default values for parametering the boiler efficiency method .....	50
B.1	Information on the method.....	50
B.2	Conversion of the energy content of energy carriers .....	57
B.3	Deviation from default values .....	57
B.4	Fuel constants for flue gas measurement depending on Siegert constants .....	57
B.5	Default values for calculation of thermal losses through the chimney with the burner off.....	59
B.6	Additional default data and calculation for condensing boilers .....	59
B.7	Additional default data for generator output and losses.....	61
B.8	Additional default data and calculation for water heaters.....	62
Annex C	(informative) General part default values and information - Boundary condition for DHW .....	63
Bibliography	.....	64

## European foreword

This document (CEN/TR 15316-6-4:2017) 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.

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

## Introduction

This document informs about EN 15316-4-1 as a part of a series of standards aimed at European harmonization of the methodology for the calculation of the energy performance of buildings.

A huge amount of informative contents needs indeed to be recorded and made available for users to properly understand, apply and nationally adapt the EPB standards.

### **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 [3].

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

EN 15316-4-1 is intended to replace EN 15316-4-1:2008 and includes Domestic hot water systems, generation (former EN 15316-3-3) and biomass boilers (former EN 15316-4-7:2008) in this standard published in 2007-2008 under the mandate M/343 on the EPBD. This revision was required as a result of the EPBD recast (2010/31/EU). The set of standards developed under mandate M/343 will be revised to become consistent with the overarching standard under mandate M/480.

The typology method has been removed, the boiler cycling method has been added for existing boilers to get the input parameters for the case specific boiler efficiency method.

Other generation systems are covered in other sub modules of part M3-8 (see Figure 1).

## 1 Scope

This Technical Report refers to EN 15316-4-1.

It contains information to support the correct understanding, use and national adaption of standard EN 15316-4-1.

## 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 89, *Gas-fired storage water heaters for the production of domestic hot water*

EN 13203-2, *Gas-fired domestic appliances producing hot water - Part 2: Assessment of energy consumption*

EN 15316-4-1:2017, *Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating and DHW generation systems, combustion systems (boilers, biomass), Module M3-8-1, M8-8-1*

EN ISO 13790, *Energy performance of buildings - Calculation of energy use for space heating and cooling (ISO 13790)*

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, symbols, abbreviations and indices

### 3.1 Terms and definitions

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

### 3.2 Symbols

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

### 3.3 Abbreviations and indices

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

## 4 Description of the method

### 4.1 Output of the method

#### 4.1.1 Description

The calculation of the values takes place basically for the zones defined in EN ISO 13790.

If a number of parts of systems are contained in the various process domains then the values are to be added together for further analysis.