



BSI Standards Publication

Energy performance of buildings

Part 13: Module M4-8 - Calculation of cooling systems - Generation

National foreword

This British Standard is the UK implementation of EN 16798-13:2017. Together with BS EN 16798-9:2017 and PD CEN/TR 16798-14:2017, it supersedes BS EN 15243:2007, which is withdrawn.

BSI, as a member of CEN, is obliged to publish EN 16798-13:2017 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee voted against its approval as a European Standard.

The technical reasoning behind the UK committee's response relates to:

- a) The apparent imposition of specific requirements on National authorities
- b) The lack of guidance in EN 16798-13:2017 on accuracy and justification for the use of Methods 1 and 2 relative to existing simpler alternatives.

Users may wish to consider these issues when specifying products.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Ventilation for buildings, heating and hot water services.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Performance énergétique des bâtiments - Partie 13:
Module M4-8 - Calcul des systèmes de refroidissement
- Génération

Energieeffizienz von Gebäuden - Teil 13: M4-8 Modul -
Berechnung der Kühlsysteme - Erzeugung

This European Standard was approved by CEN on 27 February 2017.

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European foreword

This document (EN 16798-13:2017) has been prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2017 and conflicting national standards shall be withdrawn at the latest by December 2017.

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, together with parts 9 and 11 of the series, supersedes EN 15243:2007, which was produced to meet the requirements of Directive 2002/91/EC 16 December 2002 on energy performance of buildings referred to as “EPBD”.

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

This standard has been produced to meet the requirements of Directive 2010/31/EU 19 May 2010 on the energy performance of buildings (recast), referred to as “recast EPBD”.

For the convenience of Standards users CEN/TC 156, together with responsible Working Group Conveners, have prepared a simple table below relating, where appropriate, the relationship between the ‘EPBD’ and ‘recast EPBD’ standard numbers prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”.

EPBD EN Number	Recast EPBD EN Number	Title
EN 15251	EN 16798-1	Energy performance of buildings – Ventilation for buildings – Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics (Module M1-6)
N/A	CEN/TR 16798-2	Energy performance of buildings – Ventilation for buildings – Part 2: Interpretation of the requirements in EN 16798-1 – Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics (Module M1-6)
EN 13779	EN 16798-3	Energy performance of buildings – Ventilation for buildings – Part 3: For non-residential buildings – Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)

N/A	CEN/TR 16798-4	Energy performance of buildings – Ventilation for buildings – Part 4: Interpretation of the requirements in EN 16798- 3 – For non-residential buildings – Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)
EN 15241	EN 16798-5-1	Energy performance of buildings – Ventilation for buildings – Part 5-1: Calculation methods for energy requirements of ventilation and air conditioning systems (Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8) – Method 1: Distribution and generation
EN 15241	EN 16798-5-2	Energy performance of buildings – Ventilation for buildings – Part 5-2: Calculation methods for energy requirements of ventilation systems (Modules M5-6.2, M5-8.2) – Method 2: Distribution and generation
N/A	CEN/TR 16798-6	Energy performance of buildings – Ventilation for buildings – Part 6: Interpretation of the requirements in EN 16798-5-1 and EN 16798-5-2 – Calculation methods for energy requirements of ventilation and air conditioning systems (Modules M5-6, M5-8, M 6-5, M6-8 , M7-5, M7-8)
EN 15242	EN 16798-7	Energy performance of buildings – Ventilation for buildings – Part 7: Calculation methods for the determination of air flow rates in buildings including infiltration (Module M5-5)
N/A	CEN/TR 16798-8	Energy performance of buildings – Ventilation for buildings – Part 8: Interpretation of the requirements in EN 16798-7 – Calculation methods for the determination of air flow rates in buildings including infiltration – (Module M5-5)
EN 15243	EN 16798-9	Energy performance of buildings – Ventilation for buildings – Part 9: Calculation methods for energy requirements of cooling systems (Modules M4-1, M4-4, M4-9) – General
N/A	CEN/TR 16798-10	Energy performance of buildings – Ventilation for buildings – Part 10: Interpretation of the requirements in EN 16798-9 – Calculation methods for energy requirements of cooling systems (Module M4-1,M4-4, M4-9) – General
EN 15243	EN 16798-13	Energy performance of buildings – Ventilation for buildings – Part 13: Calculation of cooling systems (Module M4-8) – Generation

EN 15243	CEN/TR 16798-14	Energy performance of buildings – Ventilation for buildings – Part 14: Interpretation of the requirements in EN 16798-13 – Calculation of cooling systems (Module M4-8) – Generation
N/A	EN 16798-15	Energy performance of buildings – Ventilation for buildings – Part 15: Calculation of cooling systems (Module M4-7) – Storage
N/A	CEN/TR 16798-16	Energy performance of buildings – Ventilation for buildings – Part 16: Interpretation of the requirements in EN 16798-15 – Calculation of cooling systems (Module M4-7) – Storage
EN 15239 and EN 15240	EN 16798-17	Energy performance of buildings – Ventilation for buildings – Part 17: Guidelines for inspection of ventilation and air-conditioning systems (Module M4-11, M5-11, M6-11, M7-11)
N/A	CEN/TR 16798-18	Energy performance of buildings – Ventilation for buildings – Part 18: Interpretation of the requirements in EN 16798-17 – Guidelines for inspection of ventilation and air-conditioning systems (Module M4-11, M5-11, M6-11, M7-11)

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: 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 the United Kingdom.

Introduction

This 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 “set of EPB standards”.

All EPB standards follow specific rules to ensure overall consistency, unambiguity and transparency.

All EPB standards provide a certain flexibility with regard to the methods, the required input data and references to other EPB standards, by the introduction of a normative template in Annex A and Annex B with informative default choices.

For the correct use of this standard a normative template is given in Annex A to specify these choices. Informative default choices are provided in Annex B.

The main target groups of this standard are all the users of the set of EPB standards (e.g. engineers, regulators and programmers).

Use by or for regulators: In case the standard is used in the context of national or regional legal requirements, mandatory choices may be given at national or regional level for such specific applications. These choices (either the informative default choices from Annex B or choices adapted to national / regional needs, but in any case following the template of this Annex A) can be made available as national annex or as separate (e.g. legal) document (national data sheet).

NOTE So in this case:

- the regulators will **specify** the choices;
- the individual user will apply the standard to assess the energy performance of a building, and thereby **use** the choices made by the regulators.

Topics addressed in this standard can be subject to public regulation. Public regulation on the same topics can override the default values in Annex B of this standard. Public regulation on the same topics can even, for certain applications, override the use of this standard. Legal requirements and choices are in general not published in standards but in legal documents. In order to avoid double publications and difficult updating of double documents, a national annex may refer to the legal texts where national choices have been made by public authorities. Different national annexes or national data sheets are possible, for different applications.

It is expected, if the default values, choices and references to other EPB standards in Annex B are not followed due to national regulations, policy or traditions, that:

- national or regional authorities prepare data sheets containing the choices and national or regional values, according to the model in Annex A. In this case the National Annex (e.g. NA) refers to this text;
- or, by default, the national standards body will consider the possibility to add or include a National Annex in agreement with the template of Annex A, in accordance to the legal documents that give national or regional values and choices.

Further target groups are parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

More information is provided in the Technical Report accompanying this standard (CEN/TR 16798-14 [2], under preparation).

EPB standards deal with energy performance calculation and other related aspects (like system sizing) to provide the building services considered in the EPBD.

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

- cooling load calculation;
- energy performance calculation for ventilation, air conditioning, and cooling systems;
- inspection of ventilation and air conditioning systems; and
- installation and commissioning of ventilation and air conditioning systems.

This standard specifies a method to calculate the cooling generation of compression, absorption and other types of refrigeration systems. This standard extends EN 15243:2007, which was developed during the first EPBD mandate.

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

1 Scope

This European Standard covers the calculation of the operational parameters and the energy consumption of cooling generation systems. The cooling generation consists of:

- cooling generators like compression and absorption chillers;
- other (generic) generator types such as ground or surface water or direct use of ground heat from boreholes; and
- different types of heat rejection (dry, wet, hybrid with outdoor air, other sink types).

The methods cover:

- the possibility of heat recovery of heat to be rejected for the use of heating and/or domestic hot water production, through the use of an interface to the M3-1 standard; and
- a multi generator calculation.

The document does not cover the cooling emission, distribution and storage systems, which are covered by the Module M4-5, M4-6 and M4-7 standards, respectively. It is directly connected to the general part of the cooling systems, the M4-1 standard.

Table 1 shows the relative position of this standard within the set of EPB standards in the context of the modular structure as set out in EN ISO 52000-1:2017.

NOTE 1 In CEN ISO/TR 52000-2 the same table can be found, with, for each module, the numbers of the relevant EPB standards and accompanying Technical Reports that are published or in preparation.

NOTE 2 The modules represent EPB standards, although one EPB standard might cover more than one module and one module might be covered by more than one EPB standard, for instance a simplified and a detailed method respectively. See also Clause 2 and Tables A.1 and B.1.

Table 1 — Position of this standard (in casu M4–8) within the modular structure of the set of EPB standards

	Overarching	Building (as such)	Technical Building Systems									
Submodule	Descriptions	Descriptions	Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation and control	PV, wind, ..
sub1	M1	M2		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General	General	General									
2	Common terms and definitions; symbols, units and subscripts	Building Energy Needs	Needs								a	
3	Applications	(Free) Indoor Conditions without Systems	Maximum Load and Power									
4	Ways to Express Energy Performance	Ways to Express Energy Performance	Ways to Express Energy Performance									
5	Building categories and Building Boundaries	Heat Transfer by Transmission	Emission and control									
6	Building Occupancy and Operating Conditions	Heat Transfer by Infiltration and Ventilation	Distribution and control									
7	Aggregation of Energy Services and Energy Carriers	Internal Heat Gains	Storage and control									
8	Building zoning	Solar Heat Gains	Generation and control		EN 16798-13							
9	Calculated Energy Performance	Building Dynamics (thermal mass)	Load dispatching and operating conditions									
10	Measured Energy Performance	Measured Energy Performance	Measured Energy Performance									
11	Inspection	Inspection	Inspection									
12	Ways to Express Indoor Comfort		BMS									
13	External Environment Conditions											
14	Economic Calculation											
a The shaded modules are not applicable.												

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

EN 14511 (series), *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling*

EN 14825, *Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling - Testing and rating at part load conditions and calculation of seasonal performance*

EN 12792:2003, *Ventilation for buildings - Symbols, terminology and graphical symbols*

ISO 7345:1995, *Thermal insulation – Physical quantities and definitions*

NOTE 1 Default references to EPB standards other than EN ISO 52000-1:2017 are identified by the EPB module code number and given in Annex A (normative template) and Annex B (informative default choice).

NOTE 2 Example of EPB module code number: M5–5, or M5–5.1 (if module M5–5 is subdivided), or M5–5/1 (if reference to a specific clause of the standard covering M5–5).

3 Terms and definitions

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

NOTE The terms of EN ISO 52000-1:2017 that are indispensable for the understanding of the underlying standard are repeated here.

3.1

EPB standard

standard that complies with the requirements given in EN ISO 52000-1:2017, CEN/TS 16628 and CEN/TS 16629

Note 1 to entry: CEN/TS 16628 and CEN/TS 16629 contain specific rules to ensure overall consistency, unambiguity, transparency and flexibility, supported by common templates. EN ISO 52000-1:2017, the overarching EPB standard, is indispensable for each EPB standard, because of the modular structure, common terms and definitions, symbols and subscripts and because it provides the general framework for the EPB assessment.

[SOURCE: EN ISO 52000-1:2017]

4 Symbols and subscripts

4.1 Symbols

For the purposes of this document, the symbols given in Clause 4 and Annex C of EN ISO 52000-1:2017 and the specific symbols listed in Table 2 apply.

Table 2 — Symbols and units

Symbol	Quantity	Unit
<i>EER</i>	energy efficiency ratio	—
<i>f</i>	part-load factor	-; %
<i>k</i>	part-load stage	-; %
<i>p</i>	specific power	kW/kW
ζ	heat ratio	—

4.2 Subscripts

For the purposes of this document, the subscripts given in Clause 4 and Annex C of EN ISO 52000-1:2017, EN 12792:2003 and the specific subscripts listed in Table 3 apply.

Table 3 — Subscripts

Subscript	Term
cvd	covered
evap	evaporative
hr	heat rejection system
n	nominal
op	in operation
PL	part-load
rej	rejected
wb	wet-bulb

5 Brief description of the methods

5.1 Output of the method

The methods cover the calculation of:

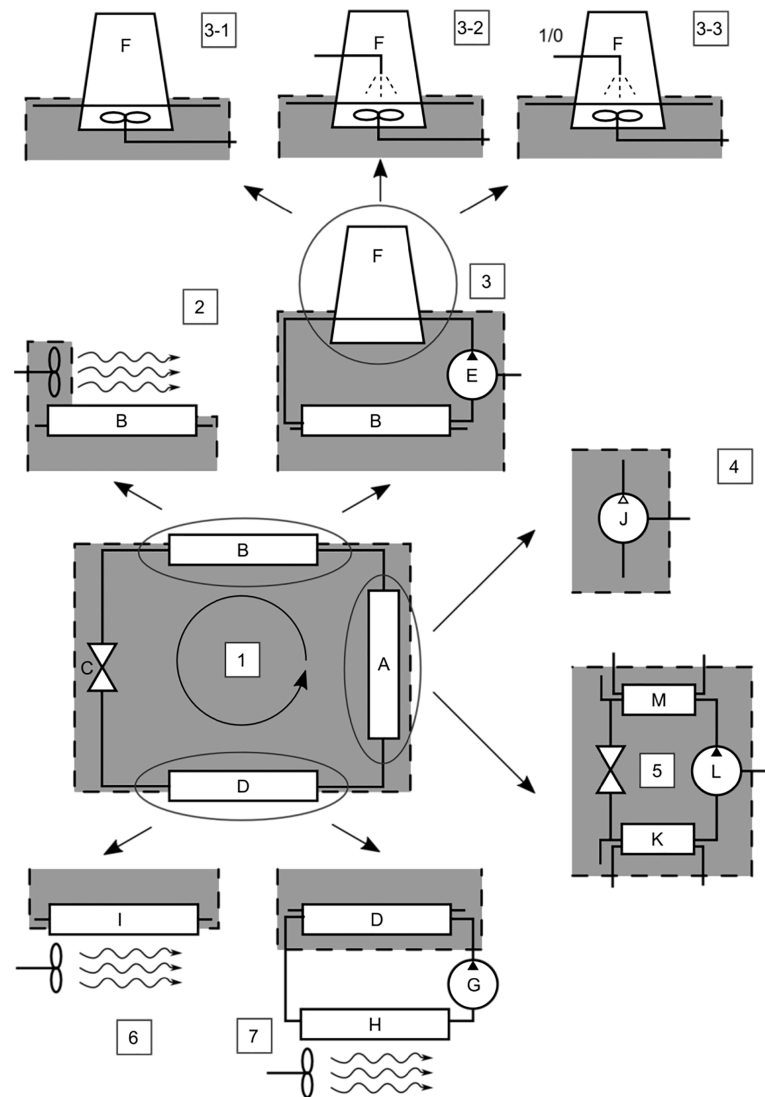
- the electrical energy (in case of compression type systems) and the heat (in case of absorption type systems) consumption for a requested cooling energy;
- the thermal energy being available for heat recovery; and
- the auxiliary energy consumption for cooling generation (e.g. power of heat rejection system (distribution and ventilation), control, sensors and actors).

The time interval of the output can be:

- annual;
- monthly; or
- hourly,

in accordance with the application of this standard.

The system design options covered within this standard are illustrated in Figure 1.



Key

A	driving component	M	desorber
B	condenser	1	basic thermodynamic circuit
C	expansion valve	2	air-cooled condenser
D	evaporator	3	water-cooled condenser
E	cooling water pump	3-1	dry heat rejection
F	cooling tower	3-2	wet heat rejection
G	chilled water pump	3-3	hybrid heat rejection
H	cooling emission (from chilled water)	4	compression type system
I	cooling emission (from refrigerant)	5	absorption type system
J	compressor	6	direct evaporation
K	absorber	7	indirect evaporation (i.e. chiller)
L	solvent pump		

Figure 1 — System design options covered within this standard

5.2 General description of the methods

There are alternative methods available. These are:

- Method 1:
 - hourly calculation interval or temperature bins, and
 - for compression chillers (air-to-air-, water/brine-to-air-, air-to-water- and water/brine-to-water units), absorption chillers and other (generic) generator types; and
- Method 2:
 - hourly or monthly calculation intervals, and
 - for chillers, (multi-)split, and variable refrigerant flow (VRF) systems.

The methods consider all the relevant parts of the basic thermodynamic circuit with special emphasis on:

- cooling generators (compression and absorption type);
- heat rejection devices (wet, dry, and hybrid); and
- control schemes.

5.3 Selection criteria between the methods

Method 1 shall be applied for systems with product data being available (e.g. part-load data in accordance with EN 14825).

Method 2 shall be applied for systems with detailed part-load data being not available or method 1 being not applicable due to other reasons (e.g. due to calculation interval restrictions).

6 Calculation method, method 1

6.1 Output data

The output data of method 1 are listed in Table 4.

Table 4 — Output data of this method

Description	Symbol	Software name	Unit	Validity interval ^a	Intended destination module ^b	Varying ^c
Cooling generation electrical energy input	$E_{C,gen,el,in}$	E_C_gen_el_in	kWh	0—∞	M1-9, M4-4	Yes
Generation system auxiliary energy input	$W_{C,aux;gen}$	W_C_aux_gen	kWh	0—∞	M1-9, M4-4	Yes
Absorption cooling generation heat input	$Q_{H,C;gen;abs,in}$	Q_H_C_gen_abs_in	kWh	0—∞	M4-4	Yes
Cooling energy extracted by generation system	$Q_{C;gen,in}$	Q_C_gen_in	kWh	0—∞	M4-1	Yes
Maximum cooling energy extracted by the generation system at the current calculation interval	$Q_{C;gen,in;max}$	Q_C_gen_in_max	kWh	0—∞	M4-1	Yes
Distribution inlet temperature from the cooling generation	$\vartheta_{C;gen,out}$	theta_C_gen_out	°C	-30—20	M4-1	Yes
Required absorption cooling generation heat input	$Q_{H,C;gen;abs,in;req}$	Q_C_gen_abs_in_req	kWh	0—∞	M3-1	Yes
Required supply temperature of absorption generation heat input	$\vartheta_{H,C;gen;abs,in;req}$	theta_H_C_abs_in_req	°C	0—∞	M3-1	Yes
Recoverable heat of the cooling generation system	$Q_{C;gen,out;rbl}$	Q_C_gen_out_rbl	kWh	0—∞	M3-1	Yes
Max. temperature level of recoverable heat	$\vartheta_{C;gen,out;max}$	theta_C_gen_out_max	°C	15—50	M3-1	Yes
Required energy to be extracted by the generation system	$Q_{C;gen,in;req}$	Q_C_gen_in_req	kWh	0—∞	M10-12	Yes
Number of generators	n_{gen}	eta_gen	—	1—10	M10-12	no
Maximum heat extraction of generator j at the current calculation interval	$Q_{C;gen,in;max;j}$	Q_C_gen_in_max(j)	kWh	0—∞	M10-12	Yes
^a Practical range, informative.						
^b Informative.						
^c "Varying": value may vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year).						

6.2 Calculation intervals

Method 1 is suitable for the following calculation intervals:

- hourly; or
- bin.

NOTE For the definition and explanation of a bin, see CEN ISO/TR 52000-2.

Dynamic effects are not taken into account.

6.3 Input data

6.3.1 Source of data, general

Input data about products that are required for the calculation described in this standard shall be the data supplied by the manufacturer if they are declared in accordance with relevant EN product standards.

If no such data from the manufacturer is available or if the required data are not product data, default values are given in Annex A.

Default informative data given in Annex A may be replaced by other data, for example nationally determined data. To ensure consistency with this calculation method, input data shall be presented in accordance with the template given in Annex B.

NOTE Compliance with the template given in Annex B does not guarantee that the new data set is consistent.

6.3.2 Product data

6.3.2.1 Product description data (qualitative)

The product description data of cooling generation systems is given by:

- GEN_TYPE: Generator type, see Table 5.

Table 5 — Identifiers for generator type

Code	Description
COMP	Compression chiller
ABS	Absorption chiller
OTHER	Any other generator type

- HEAT_REJ_TYPE: Heat rejection type, see Table 6.

Table 6 — Identifiers for heat rejection type

Code	Description
AIR_C_COND	Air cooled condenser; this is the choice in case of air-to-air or air-to-water units
DRY	Heat rejection with dry operation
WET	Heat rejection with wet operation (sprayed air cooler, cooling tower)
HYBRID	Heat rejection with dry or wet operation depending on conditions
OTHER	Other type of heat rejection (ground, ground water, surface water)

6.3.2.2 Product technical data

6.3.2.2.1 General

The product data shall be the value declared by the manufacturer in accordance with certified measurements performed in accordance with the relevant product standards. If values declared by the manufacturer are not available, then default values are given in Annex A.

Declared values are given at standard reference test conditions. Declared values shall be adjusted in accordance with actual operating conditions. This adjustment is part of the calculation procedure. This applies both to standard test values and to field test measurements.

Required technical data for this calculation procedure are listed in Table 7.

Table 7 — Product technical input data list

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c
Generator outlet temperature limit	$\vartheta_{C,gen,out;lim}$	°C		local	No
Nominal thermal power extracted from chilled water circuit	$\Phi_{C,gen;n}$	kW	0—∞	local	No
Nominal energy efficiency ratio	EER_n	—	0—100	EN 14511	No
Condensor cooling water/air inlet temperature at nominal conditions	$\vartheta_{cond,in;n}$	°C	0—∞	local	No
Evaporator chilled water outlet temperature at nominal conditions	$\vartheta_{C, evap,out;n}$	°C	0—∞	local	No
Energy efficiency at part load condition A	EER_A	—	0—100	EN 14825	No
Part load ratio A	$f_{C,PL;A}$	%	0—100	EN 14825	No
Evaporator chilled water outlet temperature at part load condition A	$\vartheta_{C, evap,out;A}$	°C	-30—20	EN 14825	No
Condensor cooling water/air inlet temperature part load condition A	$\vartheta_{cond,in;A}$	°C	0—100	EN 14825	No
Energy efficiency at part load condition B	EER_B	—	0—100	EN 14825	No
Part load ratio B	$f_{C,PL;B}$	%	0—100	EN 14825	No
Evaporator chilled water outlet temperature at part load condition B	$\vartheta_{C, evap,out;B}$	°C	-30—20	EN 14825	No
Condensor cooling water/air inlet temperature at part load condition B	$\vartheta_{cond,in;B}$	°C	0—100	EN 14825	No
Energy efficiency at part load condition C	EER_C	—	0—100	EN 14825	No
Part load ratio C	$f_{C,PL;C}$	%	0—100	EN 14825	No
Evaporator chilled water outlet temperature at part load condition C	$\vartheta_{C, evap,out;C}$	°C	-30—20	EN 14825	No
Condensor cooling water/air inlet temperature at part load condition C	$\vartheta_{cond,in;C}$	°C	0—100	EN 14825	No
Energy efficiency at part load condition D	EER_D	—	0—100	EN 14825	No

Name	Symbol	Unit	Validity interval ^a	Origin ^b	Varying ^c
Part load ratio D	$f_{C;PL;D}$	%	0—100	EN 14825	No
Evaporator chilled water outlet temperature at part load condition D	$\vartheta_{C;evap;out;D}$	°C	−30—20	EN 14825	No
Condensor cooling water/air inlet temperature at part load condition D	$\vartheta_{cond;in;D}$	°C	0—100	EN 14825	No
Energy efficiency at 5th measured point	EER_5	—	0—100	local	No
Part load ratio at 5th measured point	$f_{C;PL;5}$	%	0—100	local	No
Evaporator chilled water outlet temperature at 5th measured point	$\vartheta_{C;evap;out;5}$	°C	−30—20	local	No
Condensor cooling water/air inlet temperature at 5th measured point	$\vartheta_{cond;in;5}$	°C	0—100	local	No
Minimum part load ratio of the generator	$f_{C;PL;min}$	%	0—100	local	No
Coefficient for the calculation of absorption chiller characteristics	C_5	—	0—100	local	No
Coefficient for the calculation of absorption chiller characteristics	C_6	—	0—100	local	No
Coefficient for the calculation of absorption chiller characteristics	C_7	—	0—100	local	No
Condenser input limit temperature	$\vartheta_{cond;in;lim}$	°C	0—100	local	No
Specific electrical power consumption of the heat rejection system in dry operation	$p_{hr;el;dry}$	kW/kW	0—100	local	No
Specific electrical power consumption of the heat rejection system in wet operation	$p_{hr;el;wet}$	kW/kW	0—100	local	No
Specific electrical power consumption of the heat rejection system type OTHER	$p_{hr;el;oth}$	kW/kW	0—100	local	No
Electric power consumption of control device i (sensors, actuators, controllers)	$P_{el;C;ctrl;i}$	kW	0—∞	local	No
^a Practical range, informative. ^b For instance EPB module or (e.g. product) standard or “local” (type, geometry). ^c “Varying”: value may vary over time: different values per time interval, for instance: hourly values or monthly values (not constant values over the year).					

If default data are given on a national basis, they shall be defined in a national annex following the template in Annex A; proposed default data are given in Annex B.

6.3.2.2.2 Compressor chiller characteristics

6.3.2.2.2.1 Characteristics based on EN 14825 values

The coefficients C_1 , C_2 , C_3 , C_4 and the correction temperature difference $\Delta\vartheta_{corr}$ used for the compression chiller part load behaviour calculation in Formulae (9) and (20a) shall be obtained by solving the linear system of five equations:

$$\begin{aligned}
& \left(\frac{f_{C;PL;A}}{100} \right)^3 \cdot C_1 + \left(\frac{f_{C;PL;A}}{100} \right)^2 \cdot C_2 + \left(\frac{f_{C;PL;A}}{100} \right) \cdot C_3 + C_4 - \frac{\frac{EER_A}{EER_n} \cdot \Delta \vartheta_{\text{corr}} \cdot \left(\frac{f_{C;PL;A}}{100} \right)}{T_{0,abs} + \vartheta_{C;evap;out;A}} = \frac{\frac{EER_A}{EER_n} \cdot (\vartheta_{C;cond;in;A} - \vartheta_{C;evap;out;A})}{T_{0,abs} + \vartheta_{C;evap;out;A}}, \\
& \left(\frac{f_{C;PL;B}}{100} \right)^3 \cdot C_1 + \left(\frac{f_{C;PL;B}}{100} \right)^2 \cdot C_2 + \left(\frac{f_{C;PL;B}}{100} \right) \cdot C_3 + C_4 - \frac{\frac{EER_B}{EER_n} \cdot \Delta \vartheta_{\text{corr}} \cdot \left(\frac{f_{C;PL;B}}{100} \right)}{T_{0,abs} + \vartheta_{C;evap;out;B}} = \frac{\frac{EER_B}{EER_n} \cdot (\vartheta_{C;cond;in;B} - \vartheta_{C;evap;out;B})}{T_{0,abs} + \vartheta_{C;evap;out;B}}, \\
& \left(\frac{f_{C;PL;C}}{100} \right)^3 \cdot C_1 + \left(\frac{f_{C;PL;C}}{100} \right)^2 \cdot C_2 + \left(\frac{f_{C;PL;C}}{100} \right) \cdot C_3 + C_4 - \frac{\frac{EER_C}{EER_n} \cdot \Delta \vartheta_{\text{corr}} \cdot \left(\frac{f_{C;PL;C}}{100} \right)}{T_{0,abs} + \vartheta_{C;evap;out;C}} = \frac{\frac{EER_C}{EER_n} \cdot (\vartheta_{C;cond;in;C} - \vartheta_{C;evap;out;C})}{T_{0,abs} + \vartheta_{C;evap;out;C}}, \\
& \left(\frac{f_{C;PL;D}}{100} \right)^3 \cdot C_1 + \left(\frac{f_{C;PL;D}}{100} \right)^2 \cdot C_2 + \left(\frac{f_{C;PL;D}}{100} \right) \cdot C_3 + C_4 - \frac{\frac{EER_D}{EER_n} \cdot \Delta \vartheta_{\text{corr}} \cdot \left(\frac{f_{C;PL;D}}{100} \right)}{T_{0,abs} + \vartheta_{C;evap;out;D}} = \frac{\frac{EER_D}{EER_n} \cdot (\vartheta_{C;cond;in;D} - \vartheta_{C;evap;out;D})}{T_{0,abs} + \vartheta_{C;evap;out;D}}, \\
& \left(\frac{f_{C;PL;5}}{100} \right)^3 \cdot C_1 + \left(\frac{f_{C;PL;5}}{100} \right)^2 \cdot C_2 + \left(\frac{f_{C;PL;5}}{100} \right) \cdot C_3 + C_4 - \frac{\frac{EER_5}{EER_n} \cdot \Delta \vartheta_{\text{corr}} \cdot \left(\frac{f_{C;PL;5}}{100} \right)}{T_{0,abs} + \vartheta_{C;evap;out;5}} = \frac{\frac{EER_5}{EER_n} \cdot (\vartheta_{C;cond;in;5} - \vartheta_{C;evap;out;5})}{T_{0,abs} + \vartheta_{C;evap;out;5}}
\end{aligned} \tag{1}$$

where

$EER_{A, B, C, D}$	-	are the energy efficiency ratios from test measurements for the part load conditions A, B, C and D in accordance with EN 14825;
$\vartheta_{C;evap;out;A, B, C, D}$	°C	are the evaporator outlet temperatures corresponding to the part load conditions A, B, C and D in accordance with EN 14825;
$\vartheta_{C;cond;in;A, B, C, D}$	°C	are the condenser inlet temperatures corresponding to the part load conditions A, B, C and D in accordance with EN 14825;
$f_{C;PL;A, B, C, D}$	%	are the part load ratios for the part load conditions A, B, C and D in accordance with EN 14825;
EER_5	-	is the energy efficiency ratio at the 5th measuring point;
$\vartheta_{C;evap;out;5}$	°C	is the evaporator outlet temperatures corresponding to the EER_5 value;
$\vartheta_{C;cond;in;5}$	°C	is the condenser inlet temperatures corresponding to the EER_5 value;
$f_{C;PL;5}$	%	is the part load ratio corresponding to the EER_5 value;
EER_n	-	is the nominal energy efficiency ratio.

NOTE 1 For the method to solve the equation system of Formula (1) see the spreadsheet in the accompanying TR.

The EER_5 value shall be obtained from a fifth measurement point (supplementary to those four required by EN 14825), which shall be chosen at a part load ratio of $f_{C;PL;5} = f_{C;PL;C}$, but with the temperature of cooling water supplied to the condenser of $\vartheta_{C;cond;in;5} = \vartheta_{C;cond;in;A}$. If no such measured value is available, it is approximated according to Formula (2).

$$EER_5 = EER_C \frac{\vartheta_{C;cond;in;C} - \vartheta_{C;evap;out;C}}{\vartheta_{C;cond;in;A} - \vartheta_{C;evap;out;A}} \tag{2}$$

NOTE 2 With Formula (2) the $\Delta \vartheta_{\text{corr}}$ is 0.

NOTE 3 Alternatively the performance can be described by interpolation tabled values, if more detailed data are provided.