BS EN 14825:2016

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 14825:2016. It supersedes BS EN 14825:2013 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/17, Testing of air conditioning units.

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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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

Climatiseurs, groupes refroidisseurs de liquide et pompes à chaleur avec compresseur entraîné par moteur électrique pour le chauffage et la réfrigération des locaux - Essais et détermination des caractéristiques à charge partielle et calcul de performance saisonnière

Luftkonditionierer, Flüssigkeitskühlsätze und Wärmepumpen mit elektrisch angetriebenen Verdichtern zur Raumbeheizung und -kühlung - Prüfung und Leistungsbemessung unter Teillastbedingungen und Berechnung der saisonalen Arbeitszahl

This European Standard was approved by CEN on 20 December 2015.

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

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European foreword

This document (EN 14825:2016) has been prepared by Technical Committee CEN/TC 113 “Heat pumps and air conditioning units”, the secretariat of which is held by AENOR.

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of an identical text or by endorsement, at the latest by September 2016, and conflicting national standards shall be withdrawn at the latest by September 2016.

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 supersedes EN 14825:2013.

The revision was necessary in order to harmonize this European standard with *Commission Regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters* and *Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device.*

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Regulation(s), see informative Annex ZA and Annex ZB, which are integral parts of this document.

The technical content of the previous edition remains unchanged with the exception of the correction of some errors. The main changes with respect to requirements for *Commission Regulation (EU) No 813/2013 of 2 August 2013* and *Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013* are:

a) Clause 3 “Terms, definitions, symbols, abbreviated terms and units” has been modified in order to be harmonized with Commission Regulation (*EU*) No 813/2013;

b) harmonization of the terms for temperature applications; introduction of low, intermediate, medium and high instead of low, medium, high and very high;

c) modifications so that the text is aligned to the modified terms and definitions;

d) combination of tables for better readability:

EN 14825:2016	EN 14825:2013
Table 2	Table 2
Table 3	Table 3
Table 4	Table 4
Table 5	Table 5
Table 6	Table 6, Table 7, Table 8
Table 7	Table 9, Table 10, Table 11
Table 8	Table 12, Table 13, Table 14
Table 9	Table 15, Table 16, Table 17
Table 10	Table 18, Table 19, Table 20
Table 11	Table 21, Table 22, Table 23
Table 12	Table 24, Table 25, Table 26
Table 13	Table 27, Table 28, Table 29
Table 14	Table 30, Table 31, Table 32
Table 15	Table 33, Table 34, Table 35

e) new 7.1 for the calculation of the seasonal space heating efficiency η_S;

f) new calculation for fossil fuel backup in 7.5;

g) a new normative Annex B - Applicable climate bin hours and hours for active, thermostat-off, standby, off and crankcase heater modes for space heaters, air to water and water/brine to water units below or equal to 400 kW;

h) a new normative C.2, Template for technical data sheet for space heaters, air to water and water/brine to water units below or equal to 400 kW;

i) deletion of Annex E because it is not needed anymore; it is valid only for air conditioners < 12 kW. The tables of hours are given in Annex A;

j) new informative Annex G with a calculation example for $SCOP_{on}$ and $SCOP_{net}$ for a brine-to-water heat pump;

k) a new informative Annex ZB, Relationship between this European Standard and the requirements of Commission Regulation (EU) No 813/2013 of 02 August 2013 and the requirements of Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013;

l) structural changes to the annexes in order to have normative annexes first:

EN 14825:2016	EN 14825:2013
Annex A	Annex A
Annex B	
Annex C	Annex G
Annex D	Annex D
Annex E	Annex B
Annex F	Annex C
Annex G	-
Annex H	Annex F
Annex ZA	Annex ZA
Annex ZB	
-	Annex E
Bibliography	Bibliography

Although this document was prepared in the frame of the Commission Regulation (EU) No 206/2012 implementing Directive 2009/125/EC with regard to ecodesign requirements for air conditioners and comfort fans, it may also be used to show compliance with the requirements of the European Directive 2010/30/EU and Commission Delegated Regulation (EU) No 626/2011.

This standard was prepared in the frame of the Commission Regulation (EU) No 813/2013 implementing Directive 2009/125/EC with regard to ecodesign requirements for space heaters and combination heaters. This European standard also aims at showing compliance with the requirements of the European Directive 2010/30/EU and Commission Delegated Regulation (EU) No 811/2013.

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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Heat pumps, air conditioners and liquid chilling packages can be selected and compared at standard rating conditions. This condition does not represent the usual operating conditions of the equipment over a season. This operating condition can be better assessed by comparing equipment at representative reduced capacities and determining the Seasonal Energy Efficiency Ratio and Seasonal Coefficient of Performance.

Fixed capacity heat pumps, air conditioners and liquid chilling packages deal with varying loads by varying the operation time. The efficiency of the system is dependent on the effectiveness of the controlling thermostats. Variable capacity air conditioners, liquid chilling packages and heat pumps, by continuous or step control of the compressor, can more closely match the varying load improving system efficiency.

This European Standard provides part load conditions and calculation methods for calculating the Seasonal Energy Efficiency Ratio ($SEER_{on}$) and Seasonal Coefficient of Performance ($SCOP_{on}$ and $SCOP_{net}$) of such units when they are used to fulfil the cooling and heating demands.

Other energy consumptions can occur when the unit is not used to fulfil the cooling and heating demands such as those from a crankcase heater or when the unit is on standby. These consumptions are considered in the calculation methods for SEER and SCOP.

SEER/$SEER_{on}$ and SCOP/$SCOP_{on}$/$SCOP_{net}$ calculations may be based on calculated or measured values. In case of measured values, this European Standard gives the methods for testing heat pumps, air conditioners and liquid chilling packages at part load conditions.

The standard rating conditions and test methods are given in EN 14511-2 and EN 14511-3.

1 Scope

This European Standard covers air conditioners, heat pumps and liquid chilling packages. It applies to factory made units defined in EN 14511-1, except single duct, double duct, control cabinet and close control units.

This European Standard gives the temperatures and part load conditions and the calculation methods for the determination of seasonal energy efficiency SEER and $SEER_{on}$, seasonal coefficient of performance SCOP, $SCOP_{on}$ and $SCOP_{net}$, and seasonal space heating energy efficiency $\eta_{s.}$

Such calculation methods may be based on calculated or measured values.

In case of measured values, this European Standard covers the test methods for determination of capacities, EER and COP values during active mode at part load conditions. It also covers test methods for electric power consumption during thermostat-off mode, standby mode, off-mode and crankcase heater mode.

NOTE The word "unit" is used instead of the full terms of the products.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14511-1, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 1: Terms, definitions and classification*

EN 14511-2, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 2: Test conditions*

EN 14511-3, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 3: Test methods*

3 Terms, definitions, symbols, abbreviated terms and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14511-1 (unless otherwise stated) and the following apply.

3.1.1
active mode
mode corresponding to the hours with a cooling or heating load of the building and whereby the cooling or heating function of the unit is activated

Note 1 to entry: This condition may involve on/off-cycling of the unit in order to reach or maintain a required indoor air temperature.

3.1.2
active mode seasonal coefficient of performance
$SCOP_{on}$
average coefficient of performance of the unit in active mode for the designated heating season, determined from the part load, supplementary heating capacity (where required) and bin-specific coefficients of performance ($COP_{bin}(T_j)$) and weighted by the bin hours where the bin condition occurs

Note 1 to entry: For calculation of $SCOP_{on}$, the power consumption during thermostat-off mode, standby mode, off mode or crankcase heater mode are excluded. The power consumption of a supplementary heater is added for the part load conditions where the declared capacity of the unit is lower than the heating load, regardless whether this back up heater is included in the unit or not.

Note 2 to entry: Expressed in kWh/kWh.

3.1.3
active mode seasonal energy efficiency ratio
$SEER_{on}$
average energy efficiency ratio of the unit in active mode for the cooling function, determined from part load and bin-specific energy efficiency ratios ($EER_{bin}(T_j)$) and weighted by the bin hours where the bin condition occurs

Note 1 to entry: For calculation of $SEER_{on}$, power consumption during thermostat-off mode, standby mode, off mode or that of the crankcase heater are excluded.

Note 2 to entry: Expressed in kWh/kWh.

3.1.4
annual electricity consumption for cooling
Q_{CE}
electricity consumption [kWh] required to meet the reference annual cooling demand and calculated as the reference annual cooling demand divided by the active mode seasonal energy efficiency ratio ($SEER_{on}$) and the electricity consumption of the unit for thermostat-off-, standby-, off- and crankcase heater-mode during the cooling season

3.1.5
annual energy consumption for heating
Q_{HE}
energy consumption [kWh] which is required to meet the indicated reference annual heating demand, which pertains to a designated heating season and which is calculated as the reference annual heating demand divided by the active mode seasonal coefficient of performance ($SCOP_{on}$) and the electricity consumption of the unit for thermostat-off-, standby-, off- and crankcase heater-mode during the heating season

3.1.6
application SCOP, application $SCOP_{on}$ and application $SCOP_{net}$
SCOP and $SCOP_{on}$/$SCOP_{net}$ that take into account the specific application and the specific location of the unit, which are different from the ones used for determining the SCOP and $SCOP_{on}$/$SCOP_{net}$ given in this European Standard

Note 1 to entry: The calculation procedures used to determine the application $SCOP_{on}$/$SCOP_{net}$, if required, are those in this European Standard for $SCOP_{on}$/$SCOP_{net}$. However, the heating bins used in the calculations will be those of the actual location of the building. The heating loads as well as the hours of use will be those of the actual building.

3.1.7
application SEER and application $SEER_{on}$
SEER and $SEER_{on}$ that take into account the specific application and the specific location of the unit, which are different from the ones used for determining the SEER and $SEER_{on}$ given in this European Standard

Note 1 to entry: The calculation procedures used to determine the application $SEER_{on}$, if required, are those in this European Standard for $SEER_{on}$. However, the cooling bins used in the calculations will be those of the actual location of the building. The cooling loads as well as the hours of use will be those of the actual building.

3.1.8
average climate conditions
temperature conditions characteristic for the city of Strasbourg

3.1.9
bin
outdoor temperature interval

Note to entry: For the calculation of SCOP and SEER a bin of 1 K is used

3.1.10
bin hours
h_j
hours per season for which an outdoor temperature occurs for each bin j

3.1.11
bin limit temperature
temperature in the bin for which no more heating or cooling is required

Note 1 to entry: The bin limit temperature equals 16 °C for all climates in cooling and heating applications.

3.1.12
bin-specific coefficient of performance
$COP_{bin}(T_j)$
coefficient of performance specific for every bin j with outdoor temperature T_j in a season

3.1.13
bin-specific energy efficiency ratio
$EER_{bin}(T_j)$
energy efficiency ratio specific for every bin j with outdoor temperature T_j in a season

3.1.14
bin temperature
outdoor temperature
T_j
outdoor air dry bulb temperature

Note to entry 1: Expressed in °C

Note to entry 2: The relative humidity may be indicated by a corresponding wet bulb temperature

3.1.15
bivalent temperature
$T_{bivalent}$
lowest outdoor temperature point at which the unit is declared to have a capacity able to meet 100 % of the heating load without back up heater, whether it is integrated in the unit or not

Note 1 to entry: Below this point, the unit may still deliver capacity, but additional back up heating is necessary to fulfil the full heating load.

3.1.16
capacity control
ability of the unit to change its capacity by changing the volumetric flow rate of the refrigerant

Note 1 to entry: Units are indicated as '*fixed*' if the unit cannot change its volumetric flow rate, '*staged*' if the volumetric flow rate is changed or varied in series of not more than two steps, or '*variable*' if the volumetric flow rate is changed or varied in series of three or more steps.

3.1.17
capacity ratio
CR
cooling (or heating) part load or full load divided by the declared cooling (or heating) capacity of the unit at the same temperature conditions

3.1.18
climate conditions
temperature conditions (dry bulb) characteristic for a specific location

3.1.19
coefficient of performance at declared capacity
COP_d
declared heating capacity of the unit divided by the effective power input of the unit at specific temperature conditions, A, B, C, D, E, F and G, where applicable

Note 1 to entry: Expressed in kW/kW.

3.1.20
coefficient of performance at part load
COP_{bin}
heating capacity at part load or full load divided by the effective power input of a unit at specific temperature conditions

Note 1 to entry: When the declared capacity of the unit is higher than the heating demand, the COP includes degradation losses. When the declared capacity of the unit is lower than the heating demand (i.e. below the bivalent temperature condition), the COP of the declared capacity is used.

Note 2 to entry: Expressed in kW/kW.

3.1.21
colder climate conditions
temperature conditions characteristic for the city of Helsinki

3.1.22
conversion coefficient
CC
coefficient reflecting the estimated 40% average EU power generation efficiency referred to in Directive 2012/27/EU of the European Parliament and of the Council, the value CC is equal to 2,5

3.1.23
crankcase heater mode operating hours
H_{CK}
annual number of hours the unit is considered to be in crankcase heater mode, the value of which depends on the designated season and function

Note 1 to entry: Expressed in h.

3.1.24
crankcase heater mode power input
P_{CK}
power input of the unit due to crankcase heater operation mode

Note 1 to entry: Expressed in kW.

3.1.25
crankcase heater (operation) mode
condition where the unit has activated a heating device to avoid the refrigerant migrating to the compressor in order to limit the refrigerant concentration in oil at compressor start

3.1.26
cycling interval capacity for cooling
P_{cycc}
(time-weighted) average cooling capacity output over the cycling interval test

Note 1 to entry: Expressed in kW.

3.1.27
cycling interval capacity for heating
P_{cych}
(time-weighted) average heating capacity output over the cycling interval test

Note 1 to entry: Expressed in kW.

3.1.28
cycling interval efficiency for cooling
EER_{cyc}
average energy efficiency ratio over the cycling interval test (compressor switching on and off)

Note 1 to entry: The cycling interval efficiency for cooling is calculated as the integrated cooling capacity over the interval [kWh] divided by the integrated electric power input over that same interval [kWh].

3.1.29
cycling interval efficiency for heating
COP_{cyc}
average coefficient of performance over the cycling interval test (compressor switching on and off)

Note 1 to entry: The cycling interval efficiency for heating calculated as the integrated heating capacity over the interval [kWh] divided by the integrated electric power input over that same interval [kWh].

3.1.30
declared capacity
DC
cooling (Pdc) or heating (Pdh) capacity of the vapour compression cycle a unit can deliver at any temperature condition A, B, C, D, E, F or G, as declared by the manufacturer

Note 1 to entry: This is the capacity delivered by the refrigerant cycle of the unit without supplementary heaters, even if those are integrated in the unit.

3.1.31
degradation coefficient in cooling mode
Cdc
measure of efficiency loss in cooling mode due to the cycling of the unit

Note 1 to entry: If Cdc is not determined by measurement then the default degradation coefficient for air-to-water and water/brine-to-water units is 0,9.

Note 2 to entry: If Cdc is not determined by measurement then the default degradation coefficient for air-to-air and water/brine-to-air units is 0,25.

3.1.32
degradation coefficient in heating mode
Cdh
measure of efficiency loss in heating mode due to the cycling of the unit

Note 1 to entry: If Cdh is not determined by measurement then the default degradation coefficient for air-to-water and water/brine-to-water units is 0,9.

Note 2 to entry: If Cdh is not determined by measurement then the default degradation coefficient for air-to-air and water/brine-to-air units is 0,25.

3.1.33
electric back up heater
supplementary electric heater, with a COP of 1, considered in the calculation of SCOP and $SCOP_{on}$, regardless whether it is integrated in the unit or not

3.1.34
electric back up heater capacity
elbu(T_j)
heating capacity of a real or assumed electrical back up heater supplementing the declared capacity for heating when the capacity of the unit is lower than the heat demand for a specific bin temperature T_j

Note 1 to entry: Expressed in kW.

3.1.35
energy efficiency ratio at declared capacity
EER_d
declared cooling capacity of the unit divided by the effective power input of a unit at specific temperature conditions A, B, C, D

Note 1 to entry: Expressed in kW/kW.

3.1.36
energy efficiency ratio at part load
EER_{bin}
cooling capacity at part load or full load conditions divided by the effective power input of a unit at specific temperature conditions

Note 1 to entry: The EER includes degradation losses when the declared capacity of the unit is higher than the cooling demand.

Note 2 to entry: Expressed in kW/kW.

3.1.37
equivalent active mode hours for cooling
H_{CE}
assumed annual number of hours while the unit is assumed to operate at the design load for cooling ($P_{designc}$) in order to satisfy the reference annual cooling demand

Note 1 to entry: Expressed in hours [h].

3.1.38
equivalent active mode hours for heating
H_{HE}
assumed annual number of hours while the unit is assumed to operate at the design load for heating ($P_{designh}$) in order to satisfy the reference annual heating demand

Note 1 to entry: Expressed in hours [h].

3.1.39
fixed outlet
water outlet temperature that is used when the control of the unit has no means to automatically vary the water outlet temperature with the outdoor temperature

3.1.40
fossil fuel back up heater
supplementary fossil fuel back up heater considered in the calculation of SCOP and $SCOP_{on}$. The fossil fuel back up heater shall be supplied together with the unit

3.1.41
fossil fuel back up heater efficiency
η_{sffbu}
seasonal space heating energy effiency of fossil fuel back up heater

Note 1 to entry: Expressed in %.

3.1.42
dry cooler
self-contained system that cools a single-phase liquid by rejecting sensible heat via a heat exchanger to air that is mechanically circulated by integral fan(s)

3.1.43
full load
design load
P_{design}
cooling ($P_{designc}$) or heating ($P_{designh}$) load declared by the manufacturer at T_{design} conditions

Note 1 to entry: It is possible to calculate the SEER/$SEER_{on}$ or SCOP/$SCOP_{on}$/$SCOP_{net}$ of a unit for more than one P_{design} value.

Note 2 to entry: Expressed in kW.

3.1.44
high temperature application
application where the unit delivers its declared capacity for heating at an indoor heat exchanger outlet temperature of 65°C

3.1.45
information or status display
continuous function providing information or indicating the status of the equipment on a display, including clocks

3.1.46
intermediate temperature application
application where the unit delivers its declared capacity for heating at an indoor heat exchanger outlet temperature of 45°C

3.1.47
low temperature application
application where the unit delivers its declared capacity for heating at an indoor heat exchanger outlet temperature of 35°C

3.1.48
low temperature heat pump
unit that is specifically designed for low-temperature application, and that cannot deliver heating water with an outlet temperature of 52°C at an inlet dry (wet) bulb temperature of −7°C (−8°C) in the reference design conditions for average climate

3.1.49
medium temperature application
application where the unit delivers its declared capacity for heating at an indoor heat exchanger outlet temperature of 55°C

3.1.50
net seasonal coefficient of performance
$SCOP_{net}$
seasonal efficiency of a unit in active heating mode without supplementary heaters which is determined from mandatory conditions given in this European Standard

Note 1 to entry: For calculation of $SCOP_{net}$, the electricity consumption during active mode is used. This excludes the power consumption during thermostat-off mode, standby mode, off mode or that of the crankcase heater. For the part load conditions where the declared capacity of the unit is lower than the heating load, the power consumption of a supplementary heater is not included.

Note 2 to entry: Expressed in kWh/kWh.

3.1.51
off mode
mode wherein the unit is completely switched off and cannot be reactivated by control device, external signal or by a timer

Note 1 to entry: Off mode means a condition in which the equipment is connected to the mains and is not providing any function. The following will also be considered as off mode: conditions providing only an indication of off mode condition; conditions providing only functionalities intended to ensure electromagnetic compatibility.

3.1.52
off mode operating hours
$\mathbf{H_{OFF}}$
annual number of hours the unit is considered to be in off mode, the value of which depends on the designated season and function

Note 1 to entry: Expressed in h.

3.1.53
off mode power input
$\mathbf{P_{OFF}}$
power input of the unit while in off mode

Note 1 to entry: Expressed in kW.

3.1.54
operation limit temperature
TOL
outdoor temperature below which the declared capacity is equal to zero

Note 1 to entry: Expressed in °C.

3.1.55
part load for cooling
$\mathbf{P_c(T_j)}$
cooling load at a specific outdoor temperature T_j, calculated as the design load multiplied by the part load ratio

Note 1 to entry: Expressed in kW.

3.1.56
part load for heating
$\mathbf{P_h(T_j)}$
heating load at a specific outdoor temperature T_j, calculated as the design load multiplied by the part load ratio

Note 1 to entry: Expressed in kW.

3.1.57
part load ratio
$\mathbf{pl(T_j)}$
outdoor temperature minus 16 °C divided by the reference design temperature minus 16 °C

3.1.58
reactivation function
function facilitating the activation of other modes, including active mode, by remote switch including remote control, internal sensor, timer to a condition providing additional functions, including the main function, but excluding thermostats

3.1.59
reference annual cooling demand
$\mathbf{Q_C}$
reference cooling demand to be used as basis for calculation of SEER and calculated as the product of the design load for cooling ($P_{designc}$) and the equivalent active mode hours for cooling (H_{CE})

Note 1 to entry: Expressed in kWh

3.1.60
reference annual heating demand(s)
$\mathbf{Q_H}$
reference heating demand for a designated heating season, to be used as the basis for calculating SCOP and calculated as the product of the design load for heating and the annual equivalent active mode hours

Note 1 to entry: There are three reference heating demands: "A" average, "C" colder and "W" warmer, corresponding to the three reference heating seasons.

Note 2 to entry: Expressed in kWh.

3.1.61
reference cooling season
set of operating conditions describing per bin the combination of outdoor temperatures and the number of hours these temperatures occur for cooling for which the unit is declared fit for purpose

3.1.62
reference design conditions for cooling
$\mathbf{T_{designc}}$
temperature conditions at 35 °C dry bulb (24 °C wet bulb) outdoor temperature and 27 °C dry bulb (19 °C wet bulb) indoor temperature

3.1.63
reference design conditions for heating
$\mathbf{T_{designh}}$
temperature conditions for average, colder and warmer climates

3.1.64
reference heating season(s)
set of operating conditions describing per bin the combination of outdoor temperatures and the number of hours these temperatures occur for heating for which the unit is declared fit for purpose

Note 1 to entry: There are three reference heating seasons: "A" average, "C" colder and "W" warmer.

3.1.65
seasonal coefficient of performance
SCOP
overall coefficient of performance of the unit, representative for the whole designated heating season

Note 1 to entry: The value of SCOP pertains to a designated heating season. SCOP is calculated as the reference annual heating demand divided by the annual energy consumption for heating.

Note 2 to entry: Expressed in kWh/kWh.

3.1.66
seasonal energy efficiency ratio
SEER
overall energy efficiency ratio of the unit, representative for the whole cooling season

Note 1 to entry: The seasonal energy efficiency ratio is calculated as the reference annual cooling demand divided by the annual electricity consumption for cooling.

Note 2 to entry: Expressed in kWh/kWh.

3.1.67
seasonal space heating energy efficiency
η_s
ratio between the space heating demand for a designated heating season, supplied by a space heater and the annual energy consumption required to meet this demand

Note 1 to entry: Expressed in %.

3.1.68
standby mode
mode wherein the unit is switched off partially and can be reactivated by a control device (such as a remote control), an external signal or a timer

Note 1 to entry: The unit is connected to the mains, depends on signal input to work as intended and provides only the following functions, which may persist for an indefinite time: reactivation function, or reactivation function and only an indication of enabled reactivation function, and/or information or status display.

3.1.69
standby mode operating hours
H_{SB}
annual number of hours the unit is considered to be in standby mode, the value of which depends on the designated season and function

Note 1 to entry: Expressed in h.

3.1.70
standby mode power input
P_{SB}
power input of the unit due to standby mode operation

Note 1 to entry: Expressed in kW.

3.1.71
supplementary heater
non-preferential heater that generates heat in case the heat demand is greater than the rated heat output of the preferential heater, using the Joule effect in electric heating elements or the combustion of fossil fuel

3.1.72
supplementary capacity for heating
sup(T_j)
rated heat output P_{sup} of a supplementary heater that supplements the declared capacity for heating to meet the part load for heating, if the declared capacity for heating is less than the part load for heating at a specific bin temperature T_j

Note 1 to entry: Expressed in kW

Note2 to entry: When the supplementary heater is or is assumed to be electrical then sup(T_j) is equal to elbu(T_j)

3.1.73
temperature control
equipment that interfaces with the end-user regarding the values and timing of the desired indoor temperature, and communicates relevant data to an interface of the heater such as a central processing unit, thus helping to regulate the indoor temperature(s)

3.1.74
thermostat-off mode
mode corresponding to the hours with no cooling or heating load of the building, whereby the cooling or heating function of the unit is switched on, but is not operational, as there is no cooling or heating load

Note 1 to entry: This condition is therefore related to outdoor temperatures and not to indoor loads.

Note 2 to entry: Cycling on / off in active mode is not considered as thermostat-off.

3.1.75
thermostat-off mode operating hours
H_{TO}
annual number of hours the unit is considered to be in thermostat-off mode, the value of which depends on the designated season and function

Note 1 to entry: Expressed in h.

3.1.76
thermostat-off mode power input
P_{TO}
power input of the unit due to thermostat-off mode operation

Note 1 to entry: Expressed in kW.

3.1.77
variable outlet
water outlet temperature that is used when the control of the unit has means to automatically vary the water outlet temperature with the outdoor temperature

3.1.78
warmer climate conditions
temperature conditions characteristic for the city of Athens

3.2 Symbols, abbreviated terms and units

Table 1 — Symbols, abbreviated terms and units

Symbol and abbreviated terms	Denomination	Units
CC	Conversion Coefficient	—
Cdc	Degradation Coefficient in cooling mode	—
Cdh	Degradation Coefficient in heating mode	—
COP	Coefficient of Performance	kW/kW
COP_d	Coefficient of Performance at the declared capacity	kW/kW
COP_{bin}	Coefficient of Performance at Part Load	kW/kW
$COP_{bin}(T_j)$	bin-specific Coefficient of Performance	kW/kW
COP_{cyc}	Cycling interval efficiency for heating	kW/kW
CR	Capacity Ratio	kW/kW
DC	Declared Capacity	kW
EER	Energy Efficiency Ratio	kW/kW
EER_d	Energy Efficiency Ratio at the Declared Capacity	kW/kW
EER_{bin}	Energy Efficiency Ratio at Part Load	kW/kW
$EER_{bin}(T_j)$	bin-specific Energy Efficiency Ratio	kW/kW
EER_{cyc}	Cycling interval efficiency for cooling	kW/kW
$elbu(T_j)$	Electric backup heater capacity	kW
h_j	Bin Hours	h
H_{CE}	Equivalent active mode hours for cooling	h
H_{HE}	Equivalent active mode hours for heating	h
H_{CK}	Crankcase heater mode operating hours	h
H_{OFF}	Off mode operating hours	h

Symbol and abbreviated terms	Denomination	Units
H_{SB}	Standby mode operating hours	h
H_{TO}	Thermostat-off mode operating hours	h
j	Bin number	-
n	Total number of bins	-
P_{CK}	Crankcase heater mode power consumption	kW
P_{OFF}	Off mode power consumption	kW
P_{SB}	Standby mode power consumption	kW
P_{TO}	Thermostat-off mode power input	kW
$P_c(T_j)$	Part load for cooling	kW
P_{cycc}	Cycling interval capacity for cooling	kW
P_{cych}	Cycling interval capacity for heating	kW
P_{design}	Full Load/Design load	kW
$P_{designc}$	Full Load Cooling	kW
$P_{designh}$	Full Load Heating	kW
$P_h(T_j)$	Part load for heating	kW
$pl(T_j)$	Part Load Ratio for bin temperature T_j	-
P_{sup}	Rated heat output of a supplementary heater	kW
Q_C	Reference Annual Cooling Demand	kWh
Q_{CE}	Annual electricity consumption for cooling	kWh
Q_H	Reference Annual Heating Demand	kWh
Q_{HE}	Annual energy consumption for heating	kWh
SCOP	Seasonal Coefficient of Performance	kWh/kWh
$SCOP_{net}$	Net seasonal coefficient of performance	kWh/kWh
$SCOP_{on}$	Active mode seasonal coefficient of performance	kWh/kWh
SEER	Seasonal Energy Efficiency Ratio	kWh/kWh

Symbol and abbreviated terms	Denomination	Units
$SEER_{on}$	Active mode seasonal energy efficiency ratio	kWh/kWh
$sup(T_j)$	Supplementary Capacity for Heating	kW
$T_{bivalent}$	Bivalent Temperature	°C
T_{design}	Reference Design Temperature Conditions	°C
$T_{designc}$	Reference Design Temperature Conditions for cooling	°C
$T_{designh}$	Reference Design Temperature Conditions for heating	°C
T_j	Bin Temperature Outdoor Temperature	°C
TOL	Operation Limit Temperature	°C
η_s	Seasonal Space Heating Energy Efficiency	%
η_{sffbu}	Seasonal Space Heating Energy Efficiency of Fossil Fuel Back-up Heater	%

4 Part load conditions in cooling mode

4.1 General

For the purpose of calculation of SEER/$SEER_{on}$ and application SEER as explained in Clause 6, the part load ratios mentioned below shall be based on the part load ratio formulas and not on the rounded figures of Tables 2 to 5.

For the purpose of SEER and $SEER_{on}$ the different conditions are defined by a reference design temperature $T_{designc}$ equal to 35 °C.

4.2 Air-to-air units

The part load conditions for determining the declared capacity (DC) and the declared energy efficiency ratio (EER_d) are given in the following table:

Table 2 — Part load conditions for air-to-air units

	Part load ratio	Part load ratio %	Outdoor air dry bulb temperature °C	Indoor air dry bulb (wet bulb) temperatures °C
A	$(35–16)/(T_{designc} −16)$	100	35	27(19)
B	$(30–16)/(T_{designc} −16)$	74	30	27(19)
C	$(25–16)/(T_{designc} −16)$	47	25	27(19)
D	$(20–16)/(T_{designc} −16)$	21	20	27(19)

4.3 Water-to-air units and brine-to-air units

The part load conditions for determining the declared capacity (DC) and the declared energy efficiency ratio (EER_d) are given in the following table:

Table 3 — Part load conditions for water-to-air and brine-to-air units

	Part load ratio	Part load ratio	Outdoor heat exchanger			Indoor heat exchanger
			Cooling tower [b] or water loop application Inlet/outlet water temperatures	Ground coupled application (water or brine) Inlet/outlet water temperatures	Dry cooler application Inlet/outlet water temperatures	Air dry bulb (wet bulb) temperatures
		%	°C	°C	°C	°C
A	$(35–16)/(T_{designc}−16)$	100	30 / 35	10 / 15	50 / 55	27(19)
B	$(30–16)/(T_{designc}−16)$	74	26 / [a]	10 / [a]	45 / [a]	27(19)
C	$(25–16)/(T_{designc}−16)$	47	22 / [a]	10 / [a]	40 / [a]	27(19)
D	$(20–16)/(T_{designc}−16)$	21	18 / [a]	10 / [a]	35 / [a]	27(19)

[a] With the water flow rate as determined during the “A” test.

[b] If a cooling tower and a water-to-air unit are sold as a matched assembly, they shall be tested as an air-to-air unit.

4.4 Air-to-water units

For each application, units either allowing or not allowing a variation of the outlet water temperature with the outdoor temperature are considered. The part load conditions for determining the declared capacity (DC) and the declared energy efficiency ratio (EER_d) are given in the following table.

The variable outlet temperature ($T_{outlet\_average}$) shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

For units with variable outlet that have to cycle on/off to reach the required part load ratio, the inlet and outlet temperatures of the indoor heat exchanger shall be determined according to Formula (21) in 8.4.1.

Table 4 — Part load conditions for air-to-water units

	Part load ratio	Part load ratio	Outdoor heat exchanger	Indoor heat exchanger		
			Air dry bulb temperature	Fan coil application Inlet/outlet water temperatures		Cooling floor application Inlet/outlet water temperatures
				Fixed outlet	Variable outlet	
		%	°C	°C	°C	°C
A	$(35–16)/(T_{designc} −16)$	100	35	12 / 7	12 / 7	23 / 18
B	$(30–16)/(T_{designc} −16)$	74	30	[a] / 7	[a] / 8,5	[a] / 18
C	$(25–16)/(T_{designc} −16)$	47	25	[a] / 7	[a] / 10	[a] / 18
D	$(20–16)/(T_{designc} −16)$	21	20	[a] / 7	[a] / 11,5	[a] / 18

[a] With the water flow rate as determined during “A” test for units with a fixed water flow rate or with a fixed delta T of 5 K for units with a variable water flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

4.5 Water-to-water and brine-to-water units

For each application, units either allowing or not allowing a variation of the outlet water temperature with the outdoor temperature are considered. The part load conditions for determining the declared capacity (DC) and the declared energy efficiency ratio (EER_d) are given in the following table.

The variable outlet temperature ($T_{outlet\_average}$) shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

For units with variable outlet that have to cycle on/off to reach the required part load ratio, the inlet temperature of the indoor heat exchanger shall be determined according to Formula (21) in 8.4.1.

Table 5 — Part load conditions for water-to-water units and brine-to-water units

	Part load ratio	Part load ratio	Outdoor heat exchanger			Indoor heat exchanger		
			Cooling tower [b] application Inlet/outlet water temperatures	Ground coupled application (water or brine) Inlet/outlet water temperatures	Dry cooler application Inlet/outlet water temperatures	Fan coil application Inlet/outlet water temperatures		Cooling floor application Inlet/outlet water temperatures
						Fixed outlet	Variable outlet	
		%	°C	°C	°C	°C	°C	°C
A	(35–16)/ ($T_{designc}$ −16)	100	30 / 35	10 / 15	50 / 55	12 / 7	12 / 7	23 / 18
B	(30–16)/ ($T_{designc}$ −16)	74	26 / [a]	10 / [a]	45 / [a]	[a] / 7	[a] / 8,5	[a] / 18
C	(25–16)/ ($T_{designc}$ −16)	47	22 / [a]	10 / [a]	40 / [a]	[a] / 7	[a] / 10	[a] / 18
D	(20–16)/ ($T_{designc}$ −16)	21	18 / [a]	10 / [a]	35 / [a]	[a] / 7	[a] / 11,5	[a] / 18

[a] With the water flow rate as determined during “A” test for units with a fixed water flow rate or with a fixed delta T of 5 K for units with a variable water flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] If a cooling tower and water-to-water unit are sold as a matched assembly, they shall be tested as an air-to-water unit.

5 Part load conditions in heating mode

5.1 General

For the purpose of calculation of SCOP/$SCOP_{on}$/$SCOP_{net}$ and application SCOP as explained in Clause 7, the part load ratios mentioned below shall be based on the part load ratio formulas and not on the rounded values given for each climate in the following tables.

For the purpose of SCOP and $SCOP_{on}$/$SCOP_{net}$, there are three reference design conditions: average (A), warmer (W) and colder (C).

The relevant $T_{designh}$ values are defined as follows:

— $T_{design\ “average”}$ dry bulb temperature conditions at −10 °C outdoor temperature and 20 °C indoor temperature;

— $T_{design\ “colder”}$ dry bulb temperature conditions at −22 °C outdoor temperature and 20 °C indoor temperature;

— $T_{design\ “warmer”}$ dry bulb temperature conditions at +2 °C outdoor temperature and 20 °C indoor temperature,

and the relevant $T_{bivalent}$ is defined as follows:

— for the average heating season, the dry bulb bivalent temperature is +2 °C or lower;

— for the colder heating season, the dry bulb bivalent temperature is −7 °C or lower;

— for the warmer heating season, the dry bulb bivalent temperature is +7 °C or lower.

For outdoor air dry bulb temperatures higher or equal to −10 °C the wet bulb temperature equals the dry bulb temperature minus 1 K. For dry bulb temperatures below −10 °C, the wet bulb temperature is not defined.

If the declared TOL is lower than the $T_{designh}$ of the considered climate, then the outdoor dry bulb temperature is equal to $T_{designh}$ for the part load condition E in Table 6, Tables 8 to 11.

In case of colder climate and if TOL is below −20 °C, an additional part load condition G at -15 °C shall apply.

5.2 Air-to-air units

The part load conditions for determining the declared capacity DC and the declared coefficient of performance COP_d are given in the following table:

Table 6 — Part load conditions for air-to-air units for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	**Part Load Ratio** in %				**Outdoor heat exchanger**	**Indoor heat exchanger**
	Formula	A	W	C	Inlet dry (wet) bulb temperature °C	Indoor air dry bulb temperature °C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	−7(−8)	20
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	2(1)	20
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	7(6)	20
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	12(11)	20
E	(TOL - 16) / ($T_{designh}$ - 16)				TOL	20
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				$T_{bivalent}$	20
G	(−15 - 16) / ($T_{designh}$ −16)	n/a	n/a	82	−15	20

5.3 Water-to-air and brine-to-air units

The part load conditions for determining declared capacity (DC) and the declared coefficient of performance COP_d are given in the following table:

Table 7 — Part load conditions for water/brine-to-air units for the reference heating seasons “A” = average, “W” = warmer and “C” = colder

Condition	Part Load Ratio in %				Outdoor heat exchanger inlet / outlet temperature		Indoor heat exchanger
	Formula	A	W	C	Ground water °C	Brine °C	Dry bulb °C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	10 / [a]	0 / [a]	20
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	10 / [a]	0 / [a]	20
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	10 / [a]	0 / [a]	20
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	10 / [a]	0 / [a]	20
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				10 / [a]	0 / [a]	20

[a] With the water/brine flow rate as determined at the standard rating conditions of EN 14511–2.

5.4 Air-to-water units

5.4.1 General

The part load conditions for determining the declared capacity (DC) and the declared coefficient of performance (COP_d) are given in the following tables.

The variable outlet temperature ($T_{outlet\_average}$) shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

For units with variable outlet that have to cycle on/off to reach the required part load ratio the inlet and outlet temperatures of the indoor heat exchanger shall be determined according to Formula (21) in 8.4.1.

5.4.2 Low temperature application

Table 8 — Part load conditions for air-to-water units in low temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	Part Load Ratio in %				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	−7(−8)	20(12)	[a] / 35	[a] / 34	n/a	[a] / 30
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	2(1)	20(12)	[a] / 35	[a] / 30	[a] / 35	[a] / 27
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	7(6)	20(12)	[a] / 35	[a] / 27	[a] / 31	[a] / 25
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	12(11)	20(12)	[a] / 35	[a] / 24	[a] / 26	[a] / 24
E	(TOL - 16) / ($T_{designh}$ - 16)				TOL	20(12)	[a] / 35	[a] / [b]	[a] / [b]	[a] / [b]
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				$T_{bivalent}$	20(12)	[a] / 35	[a] / [c]	[a] / [c]	[a] / [c]
G	(−15 - 16) / ($T_{designh}$ −16)	n/a	n/a	82	−15	20(12)	[a] / 35	n/a	n/a	[a] / 32

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 30/35 conditions for units with a fixed water flow rate, and with a fixed delta T of 5 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] Variable outlet shall be calculated by interpolation from $T_{designh}$ and the temperature which is closest to the TOL.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.4.3 Intermediate temperature application

Table 9 — Part load conditions for air-to-water units in intermediate temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	Part Load Ratio in %				Outdoor heat exchanger: Inlet dry (wet) bulb temperature °C		Indoor heat exchanger: Fixed outlet °C	Indoor heat exchanger: Variable outlet[d] °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	$(-7 - 16) / (T_{designh} - 16)$	88	n/a	61	−7(−8)	20(12)	a / 45	a / 43	n/a	a / 38
B	$(+2 - 16) / (T_{designh} - 16)$	54	100	37	2(1)	20(12)	a / 45	a / 37	a / 45	a / 33
C	$(+7 - 16) / (T_{designh} - 16)$	35	64	24	7(6)	20(12)	a / 45	a / 33	a / 39	a / 30
D	$(+12 - 16) / (T_{designh} - 16)$	15	29	11	12(11)	20(12)	a / 45	a / 28	a / 31	a / 26
E	$(TOL - 16) / (T_{designh} - 16)$				TOL	20(12)	a / 45	a / b	a / b	a / b
F	$(T_{bivalent} - 16) / (T_{designh} - 16)$				$T_{bivalent}$	20(12)	a / 45	a / c	a / c	a / c
G	$(-15 - 16) / (T_{designh} - 16)$	n/a	n/a	82	−15	20(12)	a / 45	n/a	n/a	a / 41

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 40/45 conditions for units with a fixed water flow rate, and with a fixed delta T of 5 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] Variable outlet shall be calculated by interpolation from $T_{designh}$ and the temperature which is closest to the TOL.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.4.4 Medium temperature application

Table 10 — Part load conditions for air-to-water units in medium temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	**Part Load Ratio** in %				**Outdoor heat exchanger**		**Indoor heat exchanger**			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	−7(−8)	20(12)	[a] / 55	[a] / 52	n/a	[a] / 44
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	2(1)	20(12)	[a] / 55	[a] / 42	[a] / 55	[a] / 37
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	7(6)	20(12)	[a] / 55	[a] / 36	[a] / 46	[a] / 32
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	12(11)	20(12)	[a] / 55	[a] / 30	[a] / 34	[a] / 28
E	(TOL - 16) / ($T_{designh}$ −16)				TOL	20(12)	[a] / 55	[a] / [b]	[a] / [b]	[a] / [b]
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				$T_{bivalent}$	20(12)	[a] / 55	[a] / [c]	[a] / [c]	[a] / [c]
G	(−15 - 16) / ($T_{designh}$ −16)	n/a	n/a	82	−15	20(12)	[a] / 55	n/a	n/a	[a] / 49

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 47/55 conditions for units with a fixed water flow rate, and with a fixed delta T of 8 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] Variable outlet shall be calculated by interpolation $T_{designh}$ and the temperature which is closest to the TOL.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.4.5 High temperature application

Table 11 — Part load conditions for air-to-water units in high temperature application for the reference heating seasons “A” = average, “W” = warmer and “C” = colder

Condition	Part Load Ratio in %				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	−7(−8)	20(12)	[a] / 65	[a] / 61	n/a	[a] / 50
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	2(1)	20(12)	[a] / 65	[a] / 49	[a] / 65	[a] / 41
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	7(6)	20(12)	[a] / 65	[a] / 41	[a] / 53	[a] / 36
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	12(11)	20(12)	[a] / 65	[a] / 32	[a] / 39	[a] / 30
E	(TOL - 16) / ($T_{designh}$ −16)				TOL	20(12)	[a] / 65	[a] / [b]	[a] / [b]	[a] / [b]
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				$T_{bivalent}$	20(12)	[a] / 65	[a] / [c]	[a] / [c]	[a] / [c]
G	(−15 - 16) / ($T_{designh}$ −16)	n/a	n/a	82	−15	20(12)	[a] / 65	n/a	n/a	[a] / 57

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 55/65 conditions for units with a fixed water flow rate, and with a fixed delta T of 10 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] Variable outlet shall be calculated by interpolation from $T_{designh}$ and the temperature which is closest to the TOL.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.5 Water-to-water and brine-to-water units

5.5.1 General

The part load conditions for determining the declared capacity DC and the declared coefficient of performance (COP_d) are given in the following tables.

The variable outlet temperature ($T_{outlet\_average}$) shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

For units with variable outlet that have to cycle on/off to reach the required part load ratio, the inlet temperature of the indoor heat exchanger shall be determined according to Formula (21) in 8.4.1.

5.5.2 Low temperature application

Table 12 — Part load conditions for water/brine-to-water units in low temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	Part Load Ratio in %				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet / outlet temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Ground water	Brine	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	10 / [b]	0 / [b]	[a] / 35	[a] / 34	n/a	[a] / 30
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	10 / [b]	0 / [b]	[a] / 35	[a] / 30	[a] / 35	[a] / 27
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	10 / [b]	0 / [b]	[a] / 35	[a] / 27	[a] / 31	[a] / 25
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	10 / [b]	0 / [b]	[a] / 35	[a] / 24	[a] / 26	[a] / 24
E	100 %				10 / [b]	0 / [b]	[a] / 35	[a] / 35	[a] / 35	[a] / 35
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				10 / [b]	0 / [b]	[a] / 35	[a] / [c]	[a] / [c]	[a] / [c]

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 30/35 conditions for units with a fixed water flow rate, and with a fixed delta T of 5 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] With the water/brine flow rate as determined at the standard rating conditions of EN 14511–2, which are the 30/35 conditions.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.5.3 Intermediate temperature application

Table 13 — Part load conditions for water/brine-to-water units in intermediate temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	**Part Load Ratio** in %				**Outdoor heat exchanger**		**Indoor heat exchanger**			
					Inlet / outlet temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Ground water	Brine	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	10 / [b]	0 / [b]	[a] / 45	[a] / 43	n/a	[a] / 38
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	10 / [b]	0 / [b]	[a] / 45	[a] / 37	[a] / 45	[a] / 33
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	10 / [b]	0 / [b]	[a] / 45	[a] / 33	[a] / 39	[a] / 30
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	10 / [b]	0 / [b]	[a] / 45	[a] / 28	[a] / 31	[a] / 26
E	100 %				10 / [b]	0 / [b]	[a] / 45	[a] / 45	[a] / 45	[a] / 45
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				10 / [b]	0 / [b]	[a] / 45	[a] / [c]	[a] / [c]	[a] / [c]

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 40/45 conditions for units with a fixed water flow rate, and with a fixed delta T of 5 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] With the water/brine flow rate as determined at the standard rating conditions of EN 14511–2, which are the 40/45 conditions.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.5.4 Medium temperature application

Table 14 — Part load conditions for water/brine-to-water units in medium temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	**Part Load Ratio** in %				**Outdoor heat exchanger**		**Indoor heat exchanger**			
					Inlet / outlet temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Ground water	Brine	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	10 / [b]	0 / [b]	[a] / 55	[a] / 52	n/a	[a] / 44
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	10 / [b]	0 / [b]	[a] / 55	[a] / 42	[a] / 55	[a] / 37
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	10 / [b]	0 / [b]	[a] / 55	[a] / 36	[a] / 46	[a] / 32
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	10 / [b]	0 / [b]	[a] / 55	[a] / 30	[a] / 34	[a] / 28
E	100 %				10 / [b]	0 / [b]	[a] / 55	[a] / 55	[a] / 55	[a] / 55
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				10 / [b]	0 / [b]	[a] / 55	[a] / [c]	[a] / [c]	[a] / [c]

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 47/55 conditions for units with a fixed water flow rate, and with a fixed delta T of 8 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] With the water/brine flow rate as determined at the standard rating conditions of EN 14511–2, which are the 47/55 conditions.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

5.5.5 High temperature application

Table 15 — Part load conditions for water/brine-to-water units in high temperature application for the reference heating seasons "A" = average, "W" = warmer and "C" = colder

Condition	Part Load Ratio in %				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet / outlet temperature °C		Fixed outlet °C	Variable outlet[d] °C		
	Formula	A	W	C	Ground water	Brine	All climates	A	W	C
A	(−7 - 16) / ($T_{designh}$ −16)	88	n/a	61	10 / [b]	0 / [b]	[a] / 65	[a] / 61	n/a	[a] / 50
B	(+2 - 16) / ($T_{designh}$ −16)	54	100	37	10 / [b]	0 / [b]	[a] / 65	[a] / 49	[a] / 65	[a] / 41
C	(+7 - 16) / ($T_{designh}$ −16)	35	64	24	10 / [b]	0 / [b]	[a] / 65	[a] / 41	[a] / 53	[a] / 36
D	(+12 - 16) / ($T_{designh}$ −16)	15	29	11	10 / [b]	0 / [b]	[a] / 65	[a] / 32	[a] / 39	[a] / 30
E	100 %				10 / [b]	0 / [b]	[a] / 65	[a] / 65	[a] / 65	[a] / 65
F	($T_{bivalent}$ - 16) / ($T_{designh}$ - 16)				10 / [b]	0 / [b]	[a] / 65	[a] / [c]	[a] / [c]	[a] / [c]

[a] With the water flow rate as determined at the standard rating conditions given in EN 14511–2 at 55/65 conditions for units with a fixed water flow rate, and with a fixed delta T of 10 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

[b] With the water/brine flow rate as determined at the standard rating conditions of EN 14511–2, which are the 55/65 conditions.

[c] Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

[d] If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

6 Calculation methods for SEER and $SEER_{on}$

6.1 General formula for calculation of SEER

The SEER equals reference annual cooling demand Q_C divided by the annual electricity consumption Q_{CE}:

$$SEER = \frac{Q_C}{Q_{CE}} \quad (1)$$

where

Q_C is the reference annual cooling demand;

Q_{CE} is the annual electricity consumption.

The climate conditions and all hours to be used for SEER calculations for air-to-air units ≤ 12 kW are given in Annex A.

6.2 Calculation of the reference annual cooling demand Q_C

The reference annual cooling demand Q_C is expressed in kWh and can be calculated as follows:

$$Q_C = P_{designc} \times H_{CE} \tag{2}$$

where

$P_{designc}$ is the design cooling load of the building the unit is suitable for as declared by the manufacturer;

H_{CE} is the number of equivalent active mode hours for cooling. This number is given in Annex A

6.3 Calculation of the reference annual electricity consumption Q_{CE}

The annual electricity consumption Q_{CE} includes the power consumption during active mode, thermostat-off mode, standby mode, off mode and that of the crankcase heater.

The power consumption during active mode is derived from the calculation of $SEER_{on}$. For determination of $SEER_{on}$, see 6.4.

$$Q_{CE} = \frac{Q_C}{SEER_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF} \tag{3}$$

where

Q_C is the reference annual cooling demand, expressed in kWh;

H_{TO}, H_{SB}, H_{CK}, H_{OFF} are the number of hours the unit is considered to work in thermostat-off mode, standby mode, crankcase heater mode and off mode respectively, expressed in hours;

P_{TO}, P_{SB}, P_{CK}, P_{OFF} are the electricity consumption during thermostat-off mode, standby mode, crankcase heater mode and off mode respectively, expressed in kW.

6.4 Calculation of $SEER_{on}$

The $SEER_{on}$ is determined as follows:

$$SEERon = \frac{\sum_{j=1}^{n} h_j \times P_c(T_j)}{\sum_{j=1}^{n} h_j \left(\frac{P_c(T_j)}{EER_{bin}(T_j)} \right)} \tag{4}$$

where

T_j is the bin temperature;

j is the bin number;

n is the total number of bins;

$P_c(T_j)$ is the cooling demand of the building for the corresponding temperature T_j;

h_j is the number of bin hours occurring at the corresponding temperature T_j;

$EER_{bin}(T_j)$ is the EER value of the unit for the corresponding temperature T_j.

The cooling demand $P_c(T_j)$ can be determined by multiplying the full load value ($P_{designc}$) with the part load ratio for each corresponding bin. This part load ratio is calculated as follows:

$pl(T_j) = (T_j-16) / (35-16)$ (5)

The EER values at each bin are determined via interpolation of the EER values at part load conditions A, B, C and D as mentioned in the tables of Clause 4.

For part load conditions above part load condition A, the same EER values as for condition A are used.

For part load conditions below part load condition D, the same EER values as for condition D are used.

6.5 Calculation procedure for determination of EER_{bin} values at part load conditions B, C, D

6.5.1 General

In part load condition A (full load), the declared capacity of a unit is considered to be equal to the cooling load ($P_{designc}$).

In part load conditions B, C and D, there can be two possibilities:

— if the declared capacity of a unit is matching with the required cooling load, the corresponding EER_d value of the unit is to be used. This may occur with staged or variable capacity units;

— if the declared capacity of a unit is higher than the required cooling load, the unit has to cycle on/off. This may occur with fixed capacity or staged or variable capacity units. In such cases, a degradation factor (Cdc) has to be used to calculate the corresponding EER_{bin} value. Such calculation is explained below.

In that case, the capacity ratio (CR) is required. CR is the ratio of the cooling demand (P_c) over the declared capacity (DC) of the unit at the same temperature conditions.

$$CR = pl(T_j) \times \frac{P_{designc}}{DC} \quad (6)$$

where

$pl(T_j)$	is the Part Load Ratio as given in (5)
$P_{designc}$	Full Load Cooling
DC	is the declared capacity of the unit at the same temperature conditions as for part load conditions B, C and D

6.5.2 Calculation procedure for fixed capacity units

6.5.2.1 Air-to-air and water-to-air units

For each part load condition B, C and D, the EER_{bin} is calculated as follows:

$$EER_{bin} = EER_d \text{ x } (1 - Cdc \text{ x } (1 - CR)) \quad (7)$$

where

EER_d	is the EER corresponding to the declared capacity (DC) of the unit at the same temperature conditions as for part load conditions B, C and D;
Cdc	is the degradation coefficient;
CR	is the capacity ratio.

For determination of the Cdc value, see 8.4.2. If Cdc is not determined by test then the default degradation coefficient Cdc shall be 0,25.

6.5.2.2 Air-to-water, water-to-water and brine-to-water units

For each part load conditions B, C and D, the EER_{bin} is calculated as follows:

$$EER_{bin} = EER_d \times \frac{CR}{Cdc \times CR + (1 - Cdc)} \tag{8}$$

where

EER_d	is the EER corresponding to the declared capacity (DC) of the unit at the same temperature conditions as for part load conditions B, C and D;
Cdc	is the degradation coefficient for cooling mode;
CR	is the capacity ratio.

For determination of the Cdc value, see 8.4.3. If Cdc is not determined by test then the default degradation coefficient Cdc shall be 0,9.

6.5.3 Calculation procedure for staged and variable capacity units

6.5.3.1 Air-to-air and water-to-air units

Determine the declared capacity and EER_d at the closest step or increment of the capacity control of the unit to reach the required cooling load. If this step allows to reach the required cooling load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required cooling load of 9 kW), the target capacity is considered as achieved and the measured EER can be used. If this step does not allow to reach the required cooling part load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required cooling load of 9 kW), determine the capacity and the effective power input at the defined part load temperatures for the steps on either side of the required cooling load. The part load power input at the required cooling part load is then determined by linear interpolation between the results obtained from these two steps. The EER_{bin} is then determined by the required cooling part load divided by the interpolated part load power input.

If the smallest control step of the unit exceeds the required cooling load by more than 10 % the EER_{bin} at the required part load ratio is calculated using Formula (7) as for fixed capacity units.

6.5.3.2 Air-to-water, water-to-water and brine-to-water units

Determine the declared capacity and EER_d at the closest step or increment of the capacity control of the unit to reach the required cooling load. If this step allows to reach the required cooling load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required cooling load of 9 kW), the target capacity is considered as achieved and the measured EER can be used. If this step does not allow to reach the required cooling part load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required cooling load of 9 kW), determine the capacity and the effective power input at the defined part load temperatures for the steps on either side of the required cooling load. The part load power input at the required cooling part load is then determined by linear interpolation between the results obtained from these two steps. The EER_{bin} is then determined by the required cooling part load divided by the interpolated part load power input.

If the smallest control step of the unit exceeds the required cooling load by more than 10 % the EER_{bin} at the required part load ratio is calculated using Formula (8) as for fixed capacity units.

7 Calculation methods for seasonal space heating efficiency η_s, SCOP, $SCOP_{on}$ and $SCOP_{net}$

7.1 Calculation of the seasonal space heating efficiency η_s

Regulations (EU) No 811/2013 and (EU) 813/2013 call for a seasonal space heating energy efficiency based on GCV of fossil fuel. The basic calculation is defined by Formula (9).

The seasonal space heating efficiency η_s [%] is defined as

$$\eta_S = \frac{1}{CC} \times SCOP - \sum F(i) \quad (9)$$

where

CC is the conversion coefficient, equal to 2,5;

ΣF(i) is the correction calculated as follows:

$$\Sigma F(i) = F(1) + F(2) \quad (10)$$

where

F(1) is the correction that accounts for a negative contribution to the seasonal space heating energy efficiency of heaters due to adjusted contributions of temperature controls, equal to 3 %;

F(2) is the correction that accounts for the negative contribution to the seasonal space heating energy efficiency by electricity consumption of brine and water pumps. This factor is only for water-/brine to water and water-/brine to air units and is equal to 5 %.

7.2 General formula for calculation of SCOP

The SCOP is defined as reference annual heating demand Q_H divided by the annual electricity consumption Q_{HE}.

$$SCOP = \frac{Q_H}{Q_{HE}} \quad (11)$$

where

Q_H is the reference annual heating demand, expressed in kWh;

Q_{HE} is the annual electricity consumption, expressed in kWh.

The climate conditions and all hours to be used for SCOP calculations for air-to-air units ≤ 12 kW are given in Annex A.

The climate conditions and all hours to be used for SCOP calculations for air-to-water and water (brine)-to-water units ≤ 400 kW are given in Annex B.

7.3 Calculation of the reference annual heating demand Q_H

The reference annual heating demand Q_H is expressed in kWh and can be calculated as follows:

$$Q_H = P_{designh} \times H_{HE} \tag{12}$$

where

$P_{designh}$ is the design heating load of the building the unit is suitable for as declared by the manufacturer, expressed in kW;

H_{HE} is the number of equivalent active mode hours for heating. This number is given in Annex A or B.

7.4 Calculation of the annual electricity consumption Q_{HE}

The annual electricity consumption includes the power consumption during active mode, thermostat-off mode, standby mode, off mode and that of the crankcase heater based on the following formula:

$$Q_{HE} = \frac{Q_H}{SCOP_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF} \tag{13}$$

where

the power consumption during active mode	is derived from the calculation of the $SCOP_{on}$; for determination of $SCOP_{on}$, see 7.5;
Q_H	is the reference annual heating demand, expressed in kWh;
H_{TO}, H_{SB}, H_{CK}, H_{OFF}	are the number of hours the unit is considered to work in thermostat-off mode, standby mode, crankcase heater mode and off mode respectively, expressed in h;
P_{TO}, P_{SB}, P_{CK}, P_{OFF}	are the power inputs during thermostat-off mode, standby mode, crankcase heater mode and off mode respectively, expressed in kW.

7.5 Calculation of $SCOP_{on}$ and $SCOP_{net}$

The $SCOP_{on}$ and $SCOP_{net}$ are determined as follows:

— For units with real or assumed electrical back up heater

$$SCOP_{on} = \frac{\sum_{j=1}^{n} h_j \left[P_h(T_j) \right]}{\sum_{j=1}^{n} h_j \left[\frac{P_h(T_j) - elbu(T_j)}{COP_{bin}(T_j)} + elbu(T_j) \right]} \tag{14}$$

$$SCOP_{net} = \frac{\sum_{j=1}^{n} h_j \left[P_h(T_j) - elbu(T_j) \right]}{\sum_{j=1}^{n} h_j \left[\frac{P_h(T_j) - elbu(T_j)}{COP_{bin}(T_j)} \right]} \tag{15}$$

— For units with supplied fossil fuel back up heater

$$SCOP_{on} = \frac{\sum_{j=1}^{n} h_j \left[P_h(T_j) \right]}{\sum_{j=1}^{n} h_j \left[\frac{P_h(T_j) - \sup(T_j)}{COP_{bin}(T_j)} + \frac{\sup(T_j)}{\eta_{sffbu} \cdot CC} \right]} \quad (16)$$

$$SCOP_{net} = \frac{\sum_{j=1}^{n} h_j \left[P_h(T_j) - \sup(T_j) \right]}{\sum_{j=1}^{n} h_j \left[\frac{P_h(T_j) - \sup(T_j)}{COP_{bin}(T_j)} \right]} \quad (17)$$

where

T_j	is the bin temperature;
j	is the bin number;
n	is the total number of bins;
$P_h(T_j)$	is the heating demand of the building for the corresponding temperature T_j, expressed in kW;
h_j	is the number of bin hours occurring at the corresponding temperature T_j;
$COP_{bin}(T_j)$	is the COP value of the unit for the corresponding temperature T_j;
elbu(T_j)	is the required capacity of an electric backup heater for the corresponding temperature T_j, expressed in kW;
sup(T_j)	is the required capacity of the fossil fuel backup heater for the corresponding temperature T_j expressed in kW;
η_{sffbu}	is the seasonal space heating energy efficiency of the fossil fuel back up heater.

For air-to-air units below or equal to 12 kW the values to be used for j, T_j and h_j are determined in Table A.2.

For air-to-water, water-to-water and brine-to-water units below 400 kW the values to be used for j, T_j and h_j are determined in Table B.1.

The heating demand $P_h(T_j)$ can be determined by multiplying the full load value ($P_{designh}$) with the part load ratio for each corresponding bin. This part load ratio is calculated as follows:

— for the average climate: $pl(T_j) = (T_j - 16) / (-10-16)$;

— for the warmer climate: $pl(T_j) = (T_j - 16) / (+2-16)$;

— for the colder climate: $pl(T_j) = (T_j - 16) / (-22-16)$.

The COP_{bin} values and capacity values at each bin are determined via interpolation of the COP_{bin} and capacity values at part load conditions A, B, C, D, E, F and G where applicable. Interpolation is done between the COP_{bin} and capacities of the 2 closest part load conditions (as mentioned in the tables of Clause 5).

The COP_{bin} values and capacity values for part load conditions above D are extrapolated from the COP_{bin} values and capacity values at part load conditions C and D.

In case of the colder climate, and if the TOL (operation limit) is below −20 °C, an additional calculation point has to be taken from the capacity and COP_{bin} at −15 °C condition (condition G).

However, if the capacity of the unit is lower than the value of $P_h(T_j)$, correction needs to be made for the missing capacity either with an electric back up heater with a COP of 1 or with the fossil fuel back up heater having an efficiency η_{sffbu} if the fossil fuel boiler is integrated in the unit.

Below TOL (operation limit) the unit is not running. The capacity of the unit at outside air temperatures below TOL is 0 kW and correction needs to be made for the missing capacity either with an electric back up heater with a COP of 1 or with the fossil fuel back up heater having an efficiency η_{sffbu} if the fossil fuel boiler is integrated in the unit.

These corrections do not apply for the calculation of $SCOP_{net}$.

7.6 Calculation procedure for determination of COP_{bin} values at part load conditions A to G

7.6.1 General

In part load conditions A to G, where applicable, there are two possibilities:

— if the declared capacity of a unit is matching with or lower than the required heating demand, the corresponding COP_d value of the unit is to be used;

— if the declared capacity of a unit is higher than the required heating demand, COP_{bin} shall be calculated according to the calculation methods below, depending on the capacity control of the unit.

CR is the ratio of the heating demand over the declared capacity (DC) of the unit at the same temperature conditions.

$$CR = pl(T_j) \times \frac{P_{designh}}{DC} \tag{18}$$

where

$P_{designh}$ is the design heating load of the building the unit is suitable for as declared by the manufacturer, expressed in kW;

$pl(T_j)$ is the part load ratio as given in 7.5;

DC is the declared capacity of the unit at the same temperature conditions as for part load conditions A to G where applicable.

7.6.2 Air-to-air, brine-to-air and water-to-air units

7.6.2.1 Calculation procedure for fixed capacity units

For the part load conditions A to G, where applicable, where the capacity ratio is lower than 1, the COP_{bin} is calculated as follows:

$$COP_{bin} = COP_d \times \left(1 - Cdh \times \left(1 - CR\right)\right) \tag{19}$$

where

COP_d is the COP corresponding to the declared capacity (DC) of the unit at the same temperature conditions as for part load conditions A to G, where applicable;

Cdh is the degradation coefficient;

CR is the capacity ratio.

For determination of the Cdh value, see 8.4.2. If Cdh is not determined by test then the default degradation coefficient Cdh shall be 0,25.

7.6.2.2 Calculation procedure for staged and variable capacity units

Determine the declared capacity and COP_{bin} at the closest step or increment of the capacity control of the unit to reach the required heat load. If this step allows to reach the required heating load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required heating load of 9 kW), the target capacity is considered as achieved and the measured COP can be used. If this step does not allow to reach the required heating part load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required heating load of 9 kW), determine the capacity and the effective power input at the defined part load temperatures for the steps on either side of the required heating load. The part load power input at the required heating part load is then determined by linear interpolation between the results obtained from these two steps. The COP_{bin} is then determined by the required heating part load divided by the interpolated part load power input.

If the smallest control step of the unit is more than 10 % higher than the required heating load, the COP_{bin} at the required part load ratio is calculated using Formula (19) as for fixed capacity units.

7.6.3 Air-to-water, water-to-water and brine-to-water units

7.6.3.1 Calculation procedure for fixed capacity units

In part load conditions A to G, where applicable, the $COP_{bin}(T_j)$ is calculated as follows:

$$COP_{bin}(T_j) = COP_d \times \frac{CR}{Cdh \times CR + (1 - Cdh)} \tag{20}$$

where

COP_d	is the COP corresponding to the declared capacity (DC) of the unit at the same temperature conditions as for part load conditions A to G, where applicable;
Cdh	is the degradation coefficient;
CR	is the capacity ratio.

For determination of the Cdh value, see 8.4.3. If Cdh is not determined by test then the default degradation coefficient Cdh shall be 0,9.

7.6.3.2 Calculation procedure for staged and variable capacity units

Determine the declared capacity and COP_{bin} at the closest step or increment of the capacity control of the unit to reach the required heat load. If this step allows to reach the required heating load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required heating load of 9 kW), the target capacity is considered as achieved and the measured COP can be used. If this step does not allow to reach the required heating part load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required heating load of 9 kW), determine the capacity and the effective power input at the defined part load temperatures for the steps on either side of the required heating load. The part load power input at the required heating part load is then determined by linear interpolation between the results obtained from these two steps. The COP_{bin} is then determined by the required heating part load divided by the part load power input.

If the smallest control step of the unit is more than 10 % higher than the required heating load, the COP_{bin} at the required part load ratio is calculated using Formula (20) as for fixed capacity units.

8 Test methods for testing capacities, EER_{bin} and COP_{bin} values during active mode at part load conditions

8.1 General

For the purposes of this European Standard, testing for capacities, EER_{bin} and COP_{bin} shall be done without including any integral supplementary back-up heating.

For testing at part load conditions, the test apparatus and the requirements given in EN 14511-3 shall apply, except when modified by the following clauses.

8.2 Basic principles

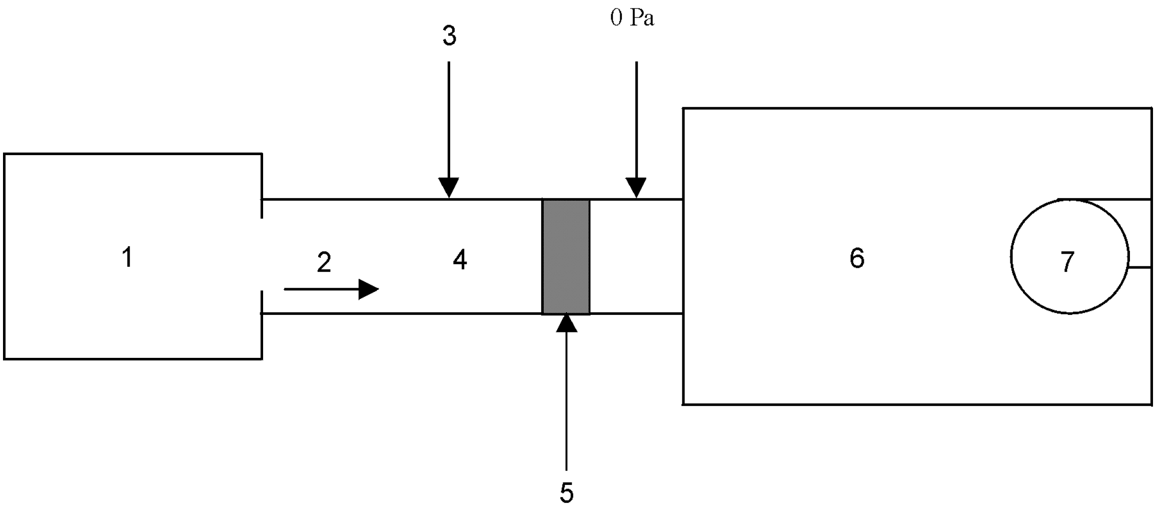
The tests shall be carried out with the electrical power supply as defined in EN 14511-2 and under the environmental conditions given in EN 14511-2, Table 1. All the tests shall be conducted according to EN 14511-3 procedure.

The fan speed shall be set to maximum airflow unless otherwise specified by the manufacturer.

In case of non-ducted appliances, the adjustable settings as louvres shall be set for minimum resistance to air flow.

For ducted units, the External Static Pressure operating conditions could be achieved by setting a damper after the section used for the measurement of the external static pressure, and by adjusting it in order to get 0 Pa static pressure after the damper, with the airflow and external static pressure remaining as during the rated capacity test (see Figure 1). This setting is made when the refrigerating system does not operate. Then the reduced capacity test is performed without changing the setting of the damper, and maintaining 0 Pa static pressure after the damper.

If other instructions are not supplied, when performing measurements in heating mode, set the highest room temperature on the unit/system control device; when performing measurements in cooling mode, set the lowest room temperature on the unit/system control device.



Key

1 object under test

2 airflow

3 external static pressure

4 duct

5 damper

6 airflow measuring apparatus

7 fan

Figure 1 — Example of test apparatus for variable airflow

In order to measure a power input that is consistent with the definition of the effective power input, if the liquid pump or the fan is an integral part of the unit and in operation, the available static pressure shall also be measured and the total measured power be corrected from the power input of the liquid pump or fan to provide this available static pressure as described in EN 14511-3. In case the correction obtains a larger value than the measured value for the electric power consumption, then the electric power consumption is set to zero.

If the liquid pump or fan is not an integral part of the unit, the power shall be corrected from the fraction of the pump or fan power that is necessary to overcome the internal static pressure difference, as described in EN 14511-3, in order to measure a power or fan input that is consistent with the definition of effective power input. To determine if the liquid pump or fan is operating the control signal shall be measured. If no control signal is available it shall be assumed that the liquid pump or fan is operating.

8.3 Uncertainties of measurement

The heating and cooling capacities measured on the liquid side shall be determined within a maximum uncertainty of (2+3/part load ratio) %.

The steady-state heating and cooling capacities determined using the calorimeter method shall be determined with a maximum uncertainty of:

— 5 % when the capacity measured is greater than 2,0 kW;

— 10 % when the capacity measured is between 1,0 kW and 2,0 kW;

— 15 % if it is lower than 1,0 kW.

The heating capacities determined during transient operation (defrost cycles) using the calorimeter method shall be determined with a maximum uncertainty of 10 %.

The heating and cooling capacities measured on the air side using the air enthalpy method shall be determined with a maximum uncertainty of (4 + 6/part load ratio) %.

All uncertainties of measurement are independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.

The maximum uncertainty of the measurement of the power input for off, thermostat off, standby and crankcase heater modes shall be

— ± 0,1 W up to 10 W;

— ± 1 % for powers greater than 10 W.

8.4 Test procedures for units with fixed capacity

8.4.1 General

Due to difficulties that will occur during on/off cycling, perform a capacity test at A to G temperature conditions according to EN 14511-3, where applicable. Calculate the Cdc or Cdh degradation coefficient or apply the default value. Apply the Formulae (7), (8), (19) or (20) to calculate the corresponding EER_{bin} and COP_{bin}. For air, water/brine-to-water units and with variable outlet temperature, in order to obtain a time averaged outlet temperature, the inlet and outlet temperatures for the capacity test shall be determined using Formula (21):

$$t_{outlet,average} = t_{inlet,capacitytest} + (t_{outlet,capacitytest} - t_{inlet,capacitytest}) \times CR \quad (21)$$

$t_{inlet,capacitytest}$ and $t_{outlet,capacitytest}$ are determined using Formula (21) in an iterative process until a convergence of 0,1 K is reached.

Note: The time averaged mean temperature should be the same when comparing variable capacity units with fixed capacity units. See example in Annex D.

8.4.2 Air-to-air and water-to-air units – Determination of the degradation coefficients Cdc and Cdh

8.4.2.1 General

When there is a cooling/heating demand, the compressor is on and the total power consumption includes all electrical auxiliary devices (electronics, fans, liquid pump etc.).

Once the set point is reached, the cooling/heating demand is satisfied. The compressor is then off but there is still a remaining power consumption due to the auxiliary devices (electronics, fans, liquid pump etc.). The degradation coefficient is due to two effects:

1) the power consumption of the unit when the compressor is off;

2) the pressure equalization that reduces the cooling/heating capacity when the unit is restarted.

For determining the degradation factor Cdc or Cdh, the unit is cycled on for 6 min and then off for 24 min for an approximately 20 % part load by switching on and off the compressor.

If it is not possible to make the measurements with the required uncertainty of measurement when using a cycling interval of 6/24 min, then another cycling interval shall be chosen but not representing a greater part load ratio than 50 % (i.e. 10/10 min).

During this cyclic test, the delivered cooling (heating) capacity is integrated over at least four on/off cycles. Then the cyclic efficiency (cooling: EER_{cyc} or heating: COP_{cyc}) is obtained by dividing the integrated cooling (P_{cycc}) (heating (P_{cych})) capacity (kWh) by the electrical energy used by the unit over the same on/off cycles.

The energy ratio is calculated by dividing the time integrated cooling (heating) capacity (kWh) (P_{cycc} or P_{cych}) by the time integrated cooling (Pdc) (heating (Pdh)) capacity (kWh) that would have been delivered by the unit running continuously for the same time.

The degradation coefficient in cooling mode (Cdc) (heating mode (Cdh)) is calculated according to the following formula:

$$Cdc = \frac{1 - \dfrac{EER_{cyc}}{EER_{continuous}}}{1 - \dfrac{\mathrm{Q}_{\mathrm{cyc}}}{\mathrm{Q}_{\mathrm{continuous}}}} \tag{22}$$

$$Cdh = \frac{1 - \dfrac{COP_{cyc}}{COP_{continuous}}}{1 - \dfrac{\mathrm{Q}_{\mathrm{cyc}}}{\mathrm{Q}_{\mathrm{continuous}}}} \tag{23}$$

where

EER_{cyc}	is the cyclic energy efficiency ratio
$EER_{continuous}$	is the continuous energy efficiency ratio
COP_{cyc}	is the cyclic coefficient of performance
$COP_{continuous}$	is the continuous coefficient of performance
Q_{cyc}	is the time integrated cooling/heating capacity during cycling
$Q_{continuous}$	is the time integrated capacity that would have been delivered by the unit

If the degradation coefficient has been determined for cooling mode (*Cdc*), it can be applied for heating mode (*Cdh*) and vice versa.

If the degradation coefficient *Cdc* or *Cdh* is not measured, a default value of 0,25 shall be used.

The temperature conditions at which the cyclic tests shall be performed are given below for each type of unit and mode.

8.4.2.2 Air-to-air units – Cooling mode

One test at an outdoor dry bulb temperature of 20 °C with dry indoor coil.

One cyclic test at the same dry bulb temperature conditions, with dry indoor coil.

8.4.2.3 Air-to-air units – Heating mode

One test at an outdoor dry bulb temperature of 12 °C with dry outdoor coil.

One cyclic test at the same dry bulb temperature conditions, with dry outdoor coil.

8.4.2.4 Water/brine-to-air units – Cooling mode

One test at the temperature condition of the “A” test given in Table 3 in 4.3 and with dry indoor coil.

One cyclic test at the same “A” test temperature conditions, with dry indoor coil.

8.4.2.5 Water-to-air units – Heating mode

One test at the temperature conditions given in the footnote of Table 7.

One cyclic test at the same test temperature conditions.

8.4.3 Air-to-water units and water-to-water units – Determination of the degradation factors Cdc and Cdh

For air-to-water units and water-to-water units, the degradation due to the pressure equalization effect when the unit restarts can be considered as negligible.

The only effect that will impact the EER/COP at cycling is the remaining power input when the compressor is switching off.

The electrical power input during the compressor off state of the unit is measured during 5 min after the compressor has been switched off for 10 min.

The degradation coefficient for cooling Cdc and the degradation coefficient for heating Cdh are determined for each part load ratio as follows:

$$Cdc = 1 - \frac{\text{effective power input of compressor off state}}{\text{effective power input (declared capacity at the part load conditions in cooling mode)}} \quad (24)$$

$$Cdh = 1 - \frac{\text{effective power input of compressor off state}}{\text{effective power input (declared capacity at the part load conditions in heating mode)}} \quad (25)$$

If the degradation coefficient Cdc or Cdh is not measured, a default value of 0,9 shall be used.

8.5 Test procedure for staged and variable capacity units

8.5.1 Settings for the required capacity ratio

The capacity ratio to be tested shall be set according to the instructions of the manufacturer. The manufacturer shall provide laboratories with the necessary information on the setting of the unit for operating at the required capacity conditions upon request. Contact information to obtain such information shall be provided in both user's manual and website of the manufacturer or importer.

The unit shall operate continuously during the part load test. The only discontinuity allowed is the defrost cycle of a unit.

For inverter type control units, if the manufacturer gives instructions for the setting of the frequency for each rating condition, this setting shall be done.

To set up a multi-split system which incorporates an inverter-controlled compressor, skilled personnel with knowledge of control software will be required. The manufacturer or his nominated agent should be in attendance when the system is being installed and prepared for tests.

8.5.2 Compensation method

For air-to-water and water/brine-to-water units, the compensation system shall allow setting of the required capacity ratio within ± 10 %. Examples of such compensation systems for part load tests in heating and cooling mode are given in Annex H.

The setting of the thermostat on the indoor water side shall be as given by the manufacturer. The test shall be performed in accordance with EN 14511-3 considering the admissible deviations, individual uncertainties of measurement and data acquisition. Cooling/heating capacity and power input are obtained by time integration over a number of complete stabilized cycles of energy balance and energy consumption. The measured cooling capacity or heating capacity shall be corrected for the heat from the circulating pump, in accordance with EN 14511-3. The effective power input shall be obtained from the measured power input and the corrections from the heat from the circulating pump(s) and/or or fan, if any.

9 Test methods for electric power input during thermostat-off mode, standby mode and crankcase heater mode and off mode

9.1 Measurement of electric power consumption during thermostat-off mode

After the unit has been running for 30 min in “D” test condition in cooling mode (for cooling only or reversible units), the thermostat set point related to the indoor temperature sensor is increased until the compressor stops. The standby power consumption (see 9.2) is deducted from the measured total energy consumption of the unit to determine the thermostat-off power on a time period of 60 min starting 10 min after the compressor stops.

For heating mode, the same principle applies but the thermostat set point should be decreased until the compressor stops after the unit has been running for 30 min in “D” test condition. No deduction of the standby power consumption shall be made for the heating mode, but the measured total energy consumption shall be considered as the thermostat off power consumption.

In case the unit is not controlled by an indoor sensor but by a heat curve related to the outdoor temperature, an increase in the outdoor temperature shall be simulated. This can either be done by increasing the local temperature around the outdoor sensor, e.g. putting it into a water bath, or by replacing it by an electrical resistance of suitable size. The simulated outdoor temperature shall be increased until the compressor stops.

In order to measure a power input that is consistent with the definition of the effective power input, if the liquid pump or the fan is an integral part of the unit and in operation during thermostat off mode, the available static pressure shall also be measured and the total thermostat-off power be corrected from the power input of the liquid pump or fan to provide this available static pressure, as described in EN 14511-3. In case the correction obtains a larger value than the measured value for the electric power consumption during thermostat off mode, then the electric power consumption during thermostat off mode is set to zero.

If the liquid pump or fan is not an integral part of the unit, the thermostat off power shall be corrected from the fraction of the pump or fan power that is necessary to overcome the internal static pressure difference as described in EN 14511-3, in order to measure a power input that is consistent with the definition of effective power input. To determine if the liquid pump or fan is operating, the control signal shall be measured. If no control signal is available, it shall be assumed that the liquid pump or fan is operating.

9.2 Measurement of the electric power consumption during standby mode

After the unit has been running for 30 min in “A” test condition in cooling mode, the unit is stopped with the control device. After 10 min, the residual energy consumption is measured and assumed to be the standby mode consumption. The measurement shall be maintained during the next 10 min and the electric power consumption during standby mode is considered as the resulting average value during this period.

For heating only units, the measurements are done in the same way after the unit has been running for 30 min in “D” test condition in heating mode.

In case it is not possible to stop the unit by any control device, the standby mode power consumption is set equal to the thermostat off mode power consumption.

9.3 Measurement of the electric power consumption during crankcase heater mode

If the crankcase heater is on during standby measurements, then the power consumption due to the crankcase heater mode shall be considered equal to the standby power consumption.

If the crankcase heater is not operating during standby measurement then a test shall be performed as follows:

After the unit has been running for 30 min in "D" test condition of the heating mode the unit is stopped with the control device, and the energy consumption of the unit shall be measured for 8 h starting 10 min after the compressor stops. Average of 8-h power input shall be calculated.

For cooling units the same test is made after the "D" test condition in cooling mode.

The standby power consumption is deducted from this measured energy consumption to determine the crankcase heater operation consumption.

NOTE It is assumed that the crankcase heater operates when the compressor is off and the outdoor temperature is lower than a given value. This value is the temperature under which the crankcase heater starts up and depends on the crankcase heater control type.

9.4 Measurement of the electric power consumption during off mode

Following the standby mode test, the unit shall be switched in off mode while remaining plugged. After 10 min, the residual energy power is measured during the next 10 min and the average value during this period is assumed to be the off mode consumption.

In case no off mode switch is available on the unit (e.g. on the indoor unit(s) for split units), the off mode power is supposed to be equal to the standby mode power. In case it is neither possible to set the unit in off mode nor in standby mode then the off mode power is assumed to be equal to the thermostat off mode power.

10 Test report

The test report shall contain general and additional information specified in EN 14511-3.

It shall also include the results of the part load test(s) and the calculation of EER or COP.

If calculation of seasonal space cooling/heating efficiency, SEER/SCOP and $SEER_{on}$/$SCOP_{on}$/$SCOP_{net}$ are included, they shall be based on the results of these tests.

For multisplit units, data shall be provided for 1 to 1 capacity ratio.

For heating application, average climate data are mandatory. Indicate with "Y" (yes) or "N" (no) the heating season the information relates to.

For units with capacity control marked 'staged' the manufacturer shall declare 2 values for the highest and lowest, noted by hi/lo divided by a slash ('/') in each box under "declared capacity".

11 Technical data sheet

The technical data sheet shall provide the necessary information for the determination of SEER/$SEER_{on}$ and/or the SCOP/$SCOP_{on}$.

The template for air-to-air units below or equal to 12 kW is defined in C.1.

The template for space heaters, air-to-water and water/brine-to-water units below or equal to 400 kW is defined in C.2.

If the SEER/$SEER_{on}$ or the SCOP/$SCOP_{on}$ is indicated in the manufacturer's data sheet, the corresponding test conditions shall be indicated with a clear reference to this European standard.

For variable capacity units, if EER_d, COP_d and declared capacities are indicated, intended for calculation of $SEER_{on}$, $SCOP_{on}$, and $SCOP_{net}$, SEER/SCOP, they shall be given at the same frequency settings for the same part load conditions.

For multisplit units, data shall be provided for 1 to 1 system capacity ratio as defined in EN 14511-1.

For heating application, average climate data are mandatory. Indicate with “Y” (yes) or “N” (no) the heating season the information relates to.

For units with capacity control marked ‘staged’ the manufacturer shall declare 2 values for the highest and lowest divided by a slash (‘/’) in each box under “declared capacity”.

Annex A
(normative)

Applicable climate bin hours and hours for active mode, thermostat-off, standby, off mode and crankcase heater mode for air conditioners below and equal to 12 kW

A.1 Climate bins

A.1.1 Bin limit temperature

The bin limit temperature for cooling and heating equals 16 °C for all climates.

A.1.2 Cooling

Following climate bins have to be used for the calculations in 6.4 for determination of $SEER_{on}$:

Table A.1 — Bin number j, outdoor temperature T_j in °C and number of hours per bin h_j corresponding to the reference cooling season

j	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
T_j	°C	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
h_j	h	205	227	225	225	216	215	218	197	178	158	137	109	88	63	39	31	24	17	13	9	4	3	1	0

A.1.3 Heating

Following climate bins have to be used for the calculations in 7.5 for determination of $SCOP_{on}$:

Table A.2 — Bin number j, outdoor temperature T_j in °C and number of hours per bin h_j corresponding to the reference heating seasons “warmer”, “average”, “colder”

		Warmer (W)	**Average (A)**	**Colder (C)**
j \#	**T_j** °C	**h_jW** h	**h_jA** h	**h_jC** h
1 to 8	−30 to −23	0	0	0
9	−22	0	0	1
10	−21	0	0	6
11	−20	0	0	13
12	−19	0	0	17
13	−18	0	0	19
14	−17	0	0	26
15	−16	0	0	39
16	−15	0	0	41
17	−14	0	0	35
18	−13	0	0	52

		Warmer (W)	Average (A)	Colder (C)
j \#	**T_j** °C	**h_jW** h	**h_jA** h	**h_jC** h
19	−12	0	0	37
20	−11	0	0	41
21	−10	0	1	43
22	−9	0	25	54
23	−8	0	23	90
24	−7	0	24	125
25	−6	0	27	169
26	−5	0	68	195
27	−4	0	91	278
28	−3	0	89	306
29	−2	0	165	454
30	−1	0	173	385
31	0	0	240	490
32	1	0	280	533
33	2	3	320	380
34	3	22	357	228
35	4	63	356	261
36	5	63	303	279
37	6	175	330	229
38	7	162	326	269
39	8	259	348	233
40	9	360	335	230
41	10	428	315	243
42	11	430	215	191
43	12	503	169	146
44	13	444	151	150
45	14	384	105	97
46	15	294	74	61
	total	3 590	4 910	6 446

A.2 Hours for active mode, thermostat-off, standby, off mode

A.2.1 Cooling

Table A.3 — Number of hours used for calculation of SEER

		Cooling only	Reversible
A	Total hours per year	8 760	8 760
B	Off mode (H_{OFF})	5 088	0
C	Difference (A-B) = hours for the reference cooling season, of which:	3 672	3 672
D	Thermostat-off (H_{TO})	221	221
E	Standby(H_{SB})	2 142	2 142
F	Difference (C-D-E) = Active mode hours without setback correction	1 309	1 309
G	Setback correction	355	355
H	Difference (F-G) = (or F × 73 %) = Active mode hours corrected for setback impact	954	954
I	Equivalent active mode hours for cooling (H_{CE})	350	350

A.2.2 Heating

Table A.4 — Number of hours used for calculation of SCOP

	Heating only			Reversible		
	"A"	"W"	"C"	"A"	"W"	"C"
Off mode (H_{OFF})	3 672 h	4 345 h	2 189 h	0 h	0 h	0 h
Thermostat-off (H_{TO})	179 h	755 h	131 h	179 h	755 h	131 h
Standby(H_{SB})	0 h	0 h	0 h	0 h	0 h	0 h
Equivalent active mode hours for heating (H_{HE})	1 400 h	1 400 h	2 100 h	1 400 h	1 400 h	2 100 h

A.3 Hours used for crankcase heater mode

A.3.1 Cooling

Table A.5 — Crankcase heater mode hours for determination of SEER

	Cooling only	Reversible
Crankcase heater (H_{CK})	7 760	2 672

A.3.2 Heating

Table A.6 — Crankcase heater mode hours for determination of SCOP

	Heating only			Reversible		
	"A"	"W"	"C"	"A"	"W"	"C"
Crankcase heater (H_{CK})	3 851 h	4 476 h	2 944 h	179 h	755 h	131 h

Annex B
(normative)

Applicable climate bin hours and hours for active, thermostat-off, standby, off and crankcase heater modes for space heaters, air to water and water/brine to water units, below or equal to 400kW

B.1 Climate bins

B.1.1 Bin limit temperature

The bin limit temperature for cooling and heating equals 16°C for all climates.

B.1.2 Heating

Following climate bins have to be used for the calculations in Clause 7.5 for determination of $SCOP_{on}$:

Table B.1 — Bin number j, outdoor temperature T_j in °C and number of hours per bin h_j corresponding to the reference heating seasons “warmer”, “average”, “colder”

		Warmer (W)	*Average (A)*	*Colder (C)*
j *#*	***T*** T_j *°C*	h_{jW} *h*	h_{jA} *h*	h_{jC} *h*
1 to 8	*-30 to −23*	*0*	*0*	*0*
9	−22	0	0	1
10	−21	0	0	6
11	−20	0	0	13
12	−19	0	0	17
13	−18	0	0	19
14	−17	0	0	26
15	−16	0	0	39
16	−15	0	0	41
17	−14	0	0	35
18	−13	0	0	52
19	−12	0	0	37
20	−11	0	0	41
21	−10	0	1	43
22	−9	0	25	54
23	−8	0	23	90
24	−7	0	24	125
25	−6	0	27	169
26	−5	0	68	195
27	−4	0	91	278
28	−3	0	89	306
29	−2	0	165	454

		Warmer (W)	*Average (A)*	*Colder (C)*
j	***T_j***	***h_{jW}***	***h_{jA}***	***h_{jC}***
#	*°C*	*h*	*h*	*h*
30	−1	0	173	385
31	0	0	240	490
32	1	0	280	533
33	2	3	320	380
34	3	22	357	228
35	4	63	356	261
36	5	63	303	279
37	6	175	330	229
38	7	162	326	269
39	8	259	348	233
40	9	360	335	230
41	10	428	315	243
42	11	430	215	191
43	12	503	169	146
44	13	444	151	150
45	14	384	105	97
46	15	294	74	61
	total	3 590	4 910	6 446

B.2 Hours for active, thermostat off, standby and off modes - Heating

Table B.2 — Number of hours used for calculation of SCOP

	Heating only			Reversible		
	"A"	"W"	"C"	"A"	"W"	"C"
Off mode (H_{OFF})	3 672 h	4 416 h	2 208 h	0 h	0 h	0 h
Thermostat off (H_{TO})	178 h	754 h	106 h	178 h	754 h	106 h
Standby (H_{SB})	0 h	0 h	0 h	0 h	0 h	0 h
Equivalent active mode hours for heating (H_{HE})	2 066 h	1 336 h	2 465 h	2 066 h	1 336 h	2 465 h

B.3 Hours used for crankcase heater mode - Heating

Table B.3 — Crankcase heater mode hours for determination of SCOP

	Heating only			Reversible		
	"A"	"W"	"C"	"A"	"W"	"C"
Crankcase heater (H_{CK})	3 850 h	5 170 h	2 314 h	178 h	754 h	106 h

Annex C
(normative)

Template for technical data sheet

C.1 For air to air units below and equal to 12 kW

Table C.1 — Technical data sheet template for air to air units below and equal to 12 kW

Model (indoor + outdoor)						
Function	Cooling				Y/N	
	Heating	Y/N	Average		Y/N	
			Warmer (if designated)		Y/N	
			Colder (if designated)		Y/N	
Capacity control	fixed				Y/N	
	staged				Y/N	
	variable				Y/N	
Design load	Cooling		Pdesignc		x,x	kW
	heating	Average	Pdesignh		x,x	kW
		Warmer	Pdesignh		x,x	kW
		Colder	Pdesignh		x,x	kW
Seasonal Efficiency	Cooling		SEER		x,x	
	heating	Average	SCOP/A		x,x	
		Warmer	SCOP/W		x,x	
		Colder	SCOP/C		x,x	
Declared capacity for cooling at indoor conditions 27(19)°C and outdoor temperature Tj	Cooling		Tj = 35 °C	Pdc	x,x	kW
			Tj = 30 °C	Pdc	x,x	kW
			Tj = 25 °C	Pdc	x,x	kW
			Tj = 20 °C	Pdc	x,x	kW
Declared energy efficiency ratio for cooling at indoor conditions 27(19)°C and outdoor temperature Tj	Cooling		Tj = 35 °C	EERd	x,x	
			Tj = 30 °C	EERd	x,x	
			Tj = 25 °C	EERd	x,x	
			Tj = 20 °C	EERd	x,x	

Declared capacity for heating at indoor conditions 20°C and outdoor temperature Tj	heating	Average	Tj = −7 °C	Pdh	x,x	kW
			Tj = 2 °C	Pdh	x,x	kW
			Tj = 7 °C	Pdh	x,x	kW
			Tj = 12 °C	Pdh	x,x	kW
			Tj = bivalent temperature	Pdh	x,x	kW
			Tj = operation limit	Pdh	x,x	kW
		Warmer	Tj = 2 °C	Pdh	x,x	kW
			Tj = 7 °C	Pdh	x,x	kW
			Tj = 12 °C	Pdh	x,x	kW
			Tj = bivalent temperature	Pdh	x,x	kW
			Tj = operation limit	Pdh	x,x	kW
		Colder	Tj = −7 °C	Pdh	x,x	kW
			Tj = 2 °C	Pdh	x,x	
			Tj = 7° C	Pdh	x,x	
			Tj = 12 °C	Pdh	x,x	
			Tj = bivalent temperature	Pdh	x,x	
			Tj = operation limit	Pdh	x,x	
			Tj = −15 °C	Pdh	x,x	

Declared coefficient of performance for heating at indoor conditions 20°C and outdoor temperature Tj	heating	Average	Tj = −7 °C	COPd	x,x
			Tj = 2 °C	COPd	x,x
			Tj = 7 °C	COPd	x,x
			Tj = 12 °C	COPd	x,x
			Tj = bivalent temperature	COPd	x,x
			Tj = operation limit	COPd	x,x
		Warmer	Tj = 2 °C	COPd	x,x
			Tj = 7 °C	COPd	x,x
			Tj = 12 °C	COPd	x,x
			Tj = bivalent temperature	COPd	x,x
			Tj = operation limit	COPd	x,x
		Colder	Tj = −7 °C	COPd	x,x
			Tj = 2 °C	COPd	x,x
			Tj = 7 °C	COPd	x,x
			Tj = 12 °C	COPd	x,x
			Tj = bivalent temperature	COPd	x,x
			Tj = operation limit	COPd	x,x
			Tj = −15 °C	COPd	x,x

Bivalent temperatures	heating	Average	$T_{bivalent}$		x	°C
		Warmer	$T_{bivalent}$		x	°C
		Colder	$T_{bivalent}$		x	°C
Operation limit temperatures	heating	Average	TOL		x	°C
		Warmer	TOL		x	°C
		Colder	TOL		x	°C
Seasonal Electricity Consumption	Cooling		QCE		x,x	kWh
	heating	Average	QHE/A		x,x	kWh
		Warmer	QHE/W		x,x	kWh
		Colder	QHE/C		x,x	kWh
modes other than “active mode”			Off mode	P_{OFF}	x,x	W
			Standby mode	P_{SB}	x,x	W
			Thermostat off mode	P_{TO}	x,x	W
			Crankcase heater mode	P_{CK}	x,x	W
Cycling mode	Power consumption		cooling	Pcycc	x,x	kW
			heating	Pcych	x,x	kW
	Efficiency		cooling	EERcyc	x,x	
			heating	COPcyc	x,x	
	Degradation coefficient		cooling	Cdc	x,x	
			heating	Cdh	x,x	
Contact details for obtaining more information			Name manufacturer			
			Address			

C.2 For space heaters, air-to-water and water/brine-to-water units below or equal to 400kW

Table C.2 — Technical data sheet template for space heaters, air-to-water and water/brine-to-water units below or equal to 400kW

Model (indoor + outdoor)	
Air-to-water heat pump	Y/N
Water-to-water heat pump	Y/N
Brine-to-water heat pump	Y/N
Low-temperature heat pump	Y/N
Equipped with supplementary heater	Y/N
Heat pump combination heater	Y/N
Parameters shall be declared for medium-temperature application, except for low-temperature heat pumps. For low temperature heat pumps, parameters shall be declared for low-temperature heat pumps	
Parameters shall be declared for average climate conditions and for warmer and/or colder climate conditions, where applicable	

Rated heat output*		Prated		x	kW
Seasonal space heating energy efficiency		η_S		x	%
Declared capacity for heating at indoor conditions 20°C and outdoor temperature Tj	climate (average, warmer or colder)	Tj = −7°C		x,x	kW
		Tj = 2°C		x,x	kW
		Tj = 7°C		x,x	kW
		Tj = 12°C		x,x	kW
		Tj = bivalent temperature		x,x	kW
		Tj = operation limit	Pdh	x,x	kW
		Tj = −15°C (if TOL < −20°C) (for air to water heat pumps)	Pdh	x,x	kW
Bivalent temperature		T_{biv}		x	°C
Degradation coefficient**		Cdh		x,x	-

Declared coefficient of performance for heating at indoor conditions 20°C and outdoor temperature Tj	Tj = −7°C	COPd	x,xx	-
	Tj = 2°C	COPd	x,xx	-
	Tj = 7°C	COPd	x,xx	-
	Tj = 12°C	COPd	x,xx	-
	Tj = bivalent temperature	COPd	x,xx	-
	Tj = operation limit	COPd	x,xx	-
	Tj = −15°C (if TOL < −20°C) (for Air to water heat pumps)	COPd	x,xx	-
Operation limit temperature	TOL		x	°C
Heating water operation limit temperature	WTOL		x	°C

Power consumption in modes other than active mode	Off mode	P_{OFF}	x	W
	Thermostat-off mode	P_{TO}	x	W
	Standby mode	P_{SB}	x	W
	Crankcase heater mode	P_{CK}	x	W
Supplementary heater	Rated heat output*	Psup	x,x	kW
	Type of energy input			

Other items	Capacity control		Fixed/Variable	
	Annual energy consumption	Q_{HE}	x	kWh

For water/brine-to-water heat pumps	Rated brine or water flow rate, outdoor heat exchanger	x	m^3/h
For air-to-water heat pumps	Rated air flow rate, outdoors	x	m^3/h

Contact details	Name and address of the manufacturer or its authorized representative

* For heat pumps space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj)

** If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9

Annex D
(informative)

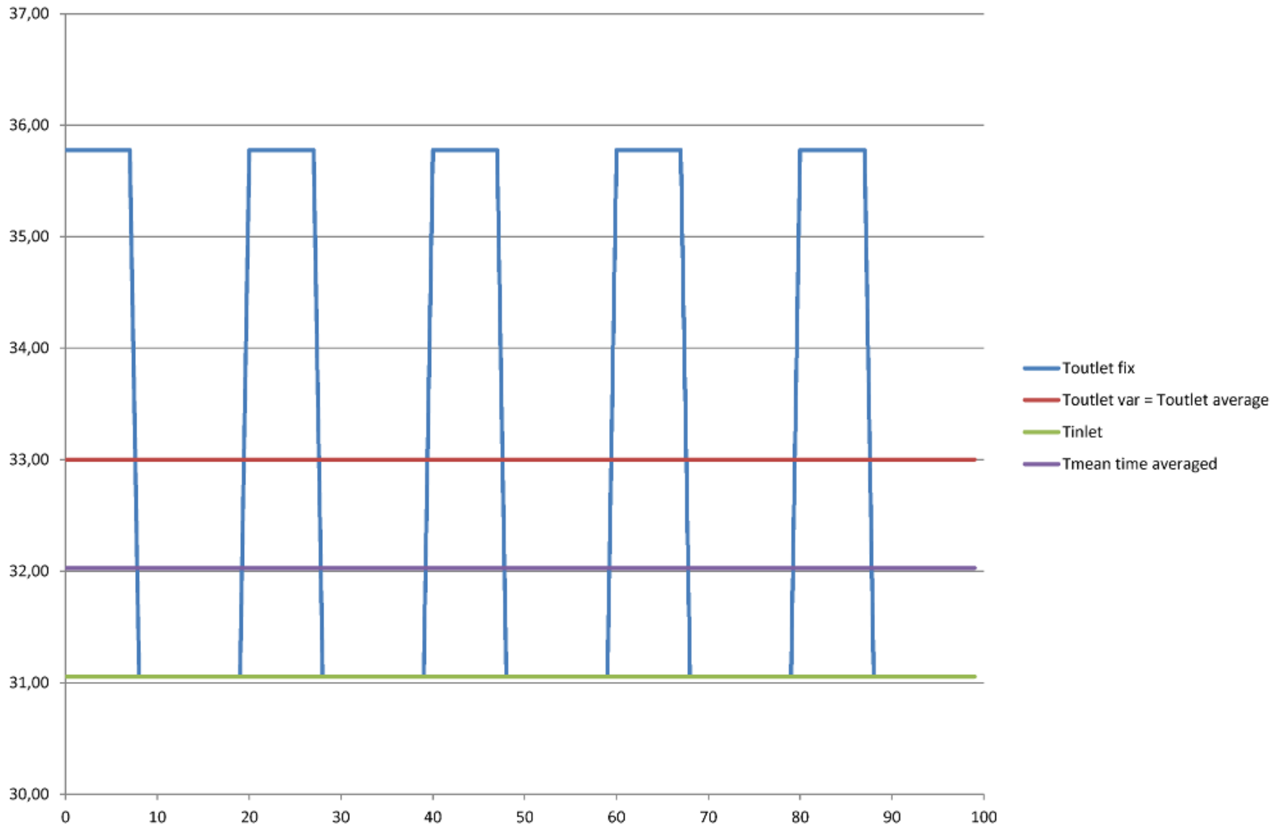
Adaption of water temperature for fixed capacity units

The mean temperature served to the heating system for a **variable capacity heat pump** is the mean value between outlet and inlet temperature.

For a **fixed capacity heat pump** when the compressor is not running the mean temperature served to the heating system is equal to the inlet temperature (= outlet temperature) of the heat pump. To compensate this low temperature when the compressor is off, the outlet temperature when the compressor is running has to be higher than that from a variable capacity heat pump to achieve the same time averaged mean temperature served to the heating system, as shown in Figure D.1.

Example for Table 9 — Part load conditions for SCOP, $SCOP_{on}$ and $SCOP_{net}$ calculation of air-to-water units for intermediate temperature application for the reference heating season "A"

– $P_{designh}$	10 kW
– Part load A	8,8 kW
– Part load B	5,4 kW
– Part load C	3,5 kW
– Part load D	1,5 kW
– Capacity at +7/45 (rating conditions)	9 kW
– Full capacity at C condition	8,5 kW
– CR (capacity ratio)	3,5/8,5 = 0,41
– dT for fixed capacity heat pump	8,5/9*5 = 4,7 K
– (dT for variable capacity heat pump)	3,5/9*5 = 1,9 K
– Outlet temperature, variable capacity heat pump	33 °C
– Inlet temperature, variable capacity and fixed capacity heat pump	33 - 1,9 = 31,1 °C
– Outlet temperature, fixed capacity heat pump	31,1 + 4,7 = 35,8 °C
– Formula (21)	33 = 31,1 + (35,8 - 31,1)*0,41



Key

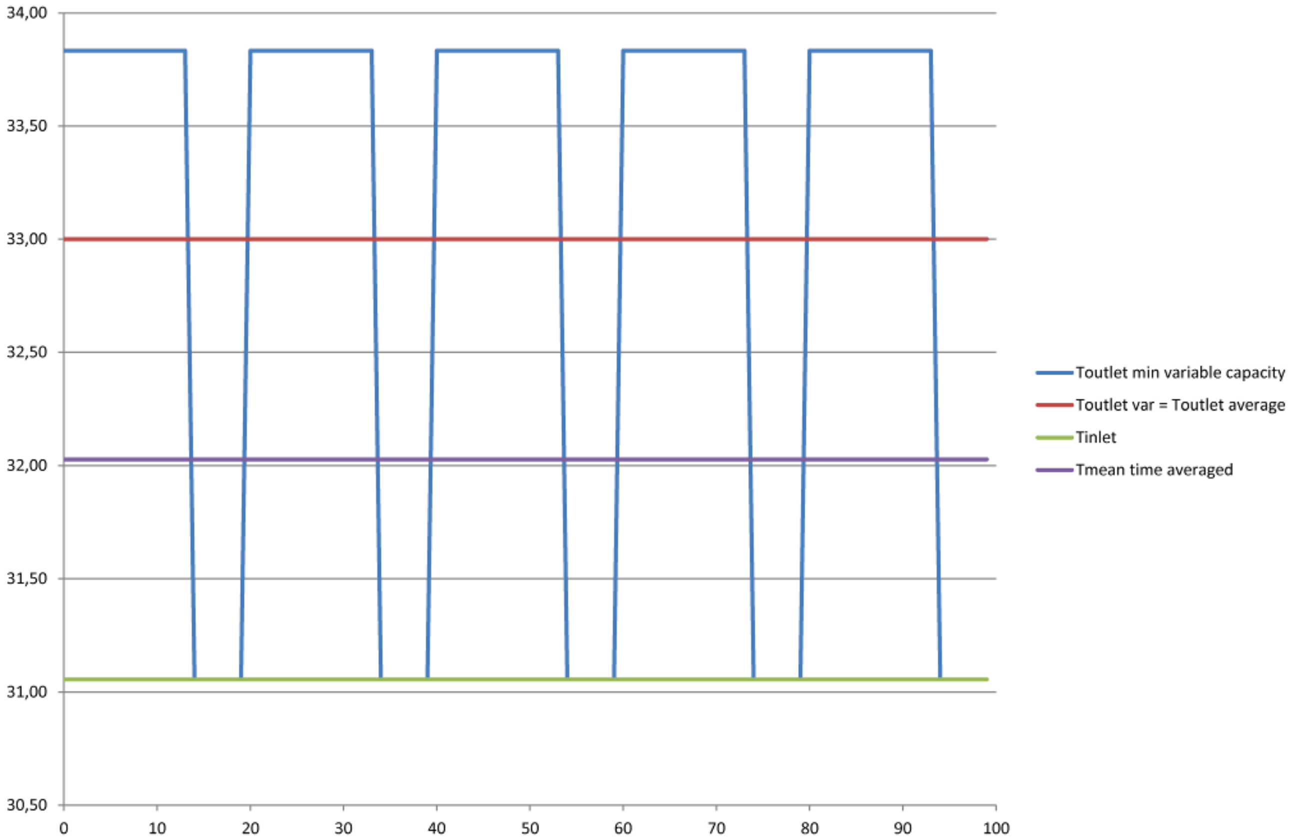
Horizontal axis =	time (in minutes)
Vertical axis =	temperature (in degrees Celsius)
T_{outlet} fix =	The outlet temperature for a fixed capacity
T_{outlet} time averaged =	The time average of the outlet temperature of an fixed speed heat pump switching on and off
T_{inlet} =	Inlet temperature
T_{mean} time averaged =	The mean value between toutlet time averaged and tinlet

Figure D.1 — Fixed capacity heat pump

The same principle applies if the minimum capacity for a variable capacity heat pump is higher than the part load, see the following example and Figure D.2.

– $P_{designh}$	10 kW
– Part load A	8,8 kW
– Part load B	5,4 kW
– Part load C	3,5 kW
– Part load D	1,5 kW
– Capacity at +7/45 (rating cond., dT = 5 K))	9 kW
– Minimum capacity at C condition	5 kW
– Part load compared to minimum capacity	3,5/5 = 0,7
– Minimum capacity compared to capacity at rating conditions	5/9 = 0,56

– dT at minimum capacity at C conditions	5/9*5 = 2,8 K
– (dT for variable capacity heat pump with minimum capacity < 3,5 kW)	3,5/9*5 = 1,9 K
– Outlet temperature, variable capacity heat pump with minimum capacity < 3,5 kW	33 °C
– Inlet temperature, variable capacity and fixed capacity heat pump	33 - 1,9 = 31,1 °C
– Outlet temperature, variable capacity heat pump with 5 kW minimum capacity at C conditions	31,1 + 2,8 = 33,8 °C
– Formula (21)	33 = 31,1 + (33,8 - 31,1)*0,7



Key

T_{outlet} time averaged =	The time average of the outlet temperature of an fixed speed heat pump switching on and off
T_{outlet} min variable capacity =	The outlet temperature at the minimum variable capacity
T_{mean} time averaged =	The mean value between toutlet time averagedand tinlet
T_{inlet} =	Inlet temperature

Figure D.2 — Variable capacity heat pump below its minimum capacity

Annex E
(informative)

Calculation example for $SEER_{on}$ and SEER – Application to a reversible air-to-air unit with variable capacity

E.1 Calculation of $SEER_{on}$

— $T_{designc}$: 35 °C

— $P_{designc}$: 3,5 kW

— Declared capacity at $T_{designc}$: 3,5 kW

From Table 2 in 4.2, the EER_{bin} can be determined for each part load ratio and for indoor and outdoor heat exchanger conditions.

Table E.1 — Data for SEER

	Outdoor air °C	**Part load ratio** %	**Part load** kW	**Declared capacity (DC)** kW	**EER at declared capacity (EER_d)**	**Cdc**	**CR** [a]	**EER at part load (EER_{bin}) (Formula (7))**
A	35	100	3,5	3,5	3	0,25	1	**3**
B	30	74	2,58	2,58	3,5	0,25	1	**3,5**
C	25	47	1,66	1,95	4	0,25	0,85	**3,85**
D	20	21	0,74	2,03	4,5	0,25	0,36	**3,78**

[a] CR = Part load divided by declared capacity.

The bold typed values are the input values for the bin calculation. These values are interpolated or extrapolated according to 6.5.

Table E.2 — Calculation BIN for $SEER_{on}$

	Bin	Outdoor temperature	Hours	Cooling load	EER_{bin}	Annual cooling demand	Annual energy input
	j	T_j	h_j	$P_c(T_j)$		$h_j \times P_c(T_j)$	$h_j \times (P_c(T_j)/EER_{bin}(T_j))$
		°C	h	kW		kWh	kWh
	1	17	205	0,18	3,78	38	10
	2	18	227	0,37	3,78	84	22
	3	19	225	0,55	3,78	124	33
D	4	20	225	0,74	**3,78**	166	44
	5	21	216	0,92	3,79	199	52
	6	22	215	1,11	3,81	238	62
	7	23	218	1,29	3,82	281	74
	8	24	197	1,47	3,84	290	76
C	9	25	178	1,66	**3,85**	295	77
	10	26	158	1,84	3,78	291	77
	11	27	137	2,03	3,71	278	75
	12	28	109	2,21	3,64	241	66
	13	29	88	2,39	3,57	211	59
B	14	30	63	2,58	**3,5**	162	46
	15	31	39	2,76	3,40	108	32
	16	32	31	2,95	3,30	91	28
	17	33	24	3,13	3,20	75	23
	18	34	17	3,32	3,10	56	18
A	19	35	13	3,50	**3,00**	46	15
	20	36	9	3,68	3,00	33	11
	21	37	4	3,87	3,00	15	5
	22	38	3	4,05	3,00	12	4
	23	39	1	4,24	3,00	4	1
	24	40	0	4,42	3,00	0	0
					Σ = = >	3 339	911

$SEER_{on}$ (Formula (4)) **3,67**

E.2 Calculation of SEER

E.2.1 Calculation of reference annual cooling demand (Q_C) according to Formula (2)

$P_{designc}$ = 3,5 kW (refer to E.1)

H_{CE} = 350 h (refer to Annex A)

Q_C = $P_{designc} \times H_{CE}$ = 1225 kWh

E.2.2 Calculation of SEER according to Formula (1)

Use the values for H_{TO}, $H_{SB,}$ H_{CK} and H_{OFF} from Table A.3 and Table A.5.

Input (Thermostat-off)	= $P_{TO} \times H_{TO}$	= 0,049 kW × 221 h	= 10,83 kWh
Input (Standby)	= $P_{SB} \times H_{SB}$	= 0,013 kW × 2 142 h	= 27,85 kWh
Input (CK)	= $P_{CK} \times H_{CK}$	= 0,0 kW × 2 672 h	= 0 kWh
Input (Off)	= $P_{OFF} \times H_{OFF}$	= 0 kW × 0 h	= 0 kWh
SEER	**= 1 225/((1 225/3,67) + 10,83 + 27,85 + 0 + 0)**		**= 3,29**

Annex F
(informative)

Calculation example for $SCOP_{on}$ and $SCOP_{net}$ - Application to a fixed capacity air-to-water heat pump used for floor heating

- $T_{designh}$: −10 °C
- $T_{bivalent}$: −6 °C
- Capacity of the unit at $T_{bivalent}$ (A-6/W33): 9,7 kW
- $P_{designh}$: 11,46 kW
- Declared capacity of the unit at $T_{designh:}$ 7,8 kW
- Climate: Average
- TOL: −10 °C
- Capacity at TOL: 7,8 kW
- Supplementary heater Electric

From Table 8 in 5.4.2, COP_{bin} can be determined for each part load ratio and for indoor and outdoor heat exchanger conditions.

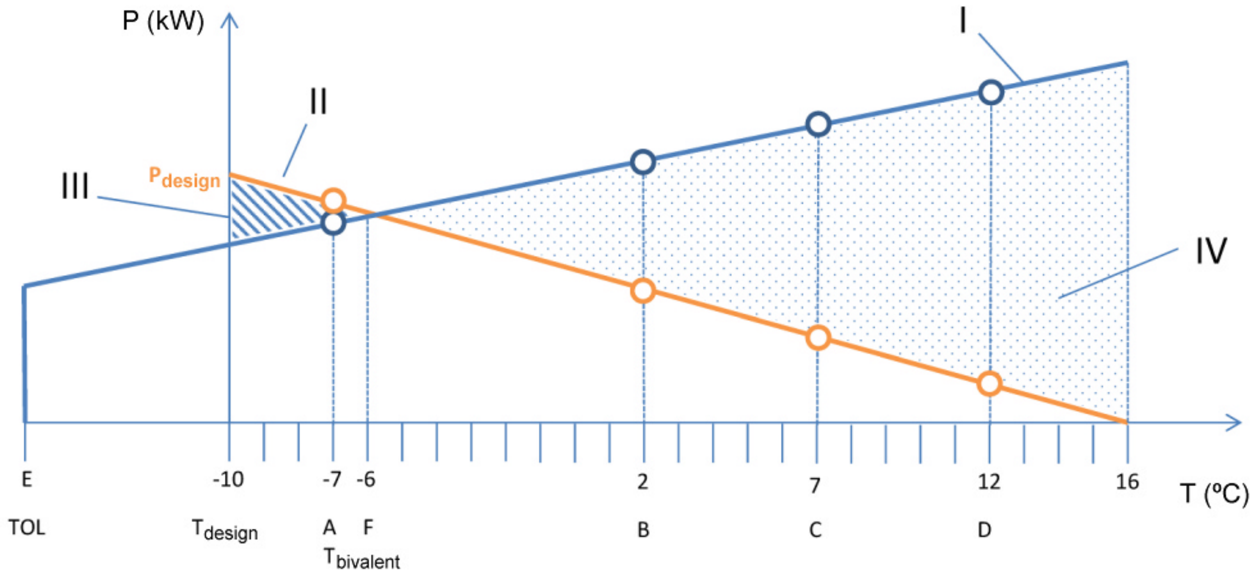
Table F.1 — Data for SCOP

	Outdoor heat exchanger	**Indoor heat exchanger**							
	Outdoor air °C	**Outlet water temperature for variable outlet °C**	**Part load ratio (%)**	**Part load (kW)**	**Declared capacity (kW)**	**COP at declared capacity COP_d**	**Cdc**	**CR [a]**	**COP at part load (Formula (20)) COP_{bin}**
A	−7	34	88 %	**10,14**	9,55	3,26	0,9	1[b]	**3,26**
B	2	30	54 %	**6,17**	11,17	4,00	0,9	0,55	**3,70**
C	7	27	35 %	**3,97**	12,66	4,91	0,9	0,31	**4,03**
D	12	24	15 %	**1,76**	14,3	5,5	0,9	0,12	**3,21**
TOL	−10	35	100 %	**11,46**	7,8	2,6	0,9	1[b]	**2,6**
$T_{bivalent}$	−6	33	85 %	**9,7**	9,7	3,3	0,9	1	**3,3**

[a] CR = part load divided by declared capacity.

[b] When the declared capacity is lower than the part load, the value of CR is considered to be equal to 1 and thus $COP_{bin}(Tj)$ equal to COP_d.

The bold typed values of Table F.1 and represented in Figure F.1 are the input values for the bin calculation. These values are interpolated or extrapolated according to 7.6 as indicated in the following Tables F.2 and F.3.



Key

T	outdoor temperature (°C)
P	capacity/load (kW)
I	declared capacity line and declared capacities at conditions A, B, C and D
II	load curve and part load capacity at conditions A, B, C, and D
III	electric back up heater
IV	on off cycling
T_{design}	reference design temperature
$T_{bivalent}$	bivalent temperature

Figure F.1 — Schematic overview of the $SCOP_{on}$ calculation points

Table F.2 — Calculation Bin for $SCOP_{on}$

	Bin	Outdoor temperature (dry bulb)	Hours	Heat load	Heat load covered by the heat pump	Electrical back up heater capacity	Annual backup heater energy input	COP_{bin} (T_j)	Annual heating demand	Annual energy input including electric back up heater [a]
	j	T_j	h_j	$P_h(T_j)$		$elbu(T_j)$	h_j × $elbu(T_j)$		$h_j \times P_h(T_j)$	
	-	°C	h	kW	kW	kW	kWh		kWh	kWh
E	21	−10	1	11,46	7,80	3,66	4	2,60	11	7
	22	−9	25	11,02	8,38	2,64	66	2,82	276	140
	23	−8	23	10,58	8,97	1,62	37	3,04	243	105
A	24	−7	24	10,14	9,55	0,59	14,18	3,26	243	84
F	25	−6	27	9,70	9,70	0,00	0,00	3,30	262	79
	26	−5	68	9,26	9,26	0,00	0,00	3,35	630	188
	27	−4	91	8,82	8,82	0,00	0,00	3,40	802	236
	28	−3	89	8,38	8,38	0,00	0,00	3,45	746	216
	29	−2	165	7,94	7,94	0,00	0,00	3,50	1 310	374
	30	−1	173	7,50	7,49	0,00	0,00	3,55	1 297	365
	31	0	240	7,05	7,05	0,00	0,00	3,60	1 693	470
	32	1	280	6,61	6,61	0,00	0,00	3,65	1 852	507
B	33	2	320	6,17	6,17	0,00	0,00	3,70	1 975	534
	34	3	357	5,73	5,73	0,00	0,00	3,77	2 046	543
	35	4	356	5,29	5,29	0,00	0,00	3,83	1 884	492
	36	5	303	4,85	4,85	0,00	0,00	3,90	1 470	377
	37	6	330	4,41	4,41	0,00	0,00	3,96	1 455	367
C	38	7	326	3,97	3,97	0,00	0,00	4,03	1 294	321
	39	8	348	3,53	3,53	0,00	0,00	3,87	1 227	318
	40	9	335	3,09	3,09	0,00	0,00	3,70	1 034	279
	41	10	315	2,65	2,64	0,00	0,00	3,54	833	236
	42	11	215	2,20	2,20	0,00	0,00	3,37	474	140
D	43	12	169	1,76	1,76	0,00	0,00	3,21	298	93
	44	13	151	1,32	1,32	0,00	0,00	3,05	200	66
	45	14	105	0,88	0,88	0,00	0,00	2,88	93	32
	46	15	74	0,44	0,43	0,00	0,00	2,72	33	12
							□	**Σ = = >**	**23 679**	**6 582**

$SCOP_{on}$ (Formula (14))	**3,61**

[a] Annual power input with resistive heat is calculated for each bin by multiplying the ratio of heat demand to COP with the number of hours of that bin with inclusion of the resistive heater according to the following formula:

$$\text{Annual power input with resistive heat} = h_j \times [(P_h(T_j) - elbu(T_j))/COP_{bin}(T_j) + elbu(T_j)] \quad \text{(F.1)}$$

Table F.3 — Calculation Bin for $SCOP_{net}$

	Bin	Outdoor temperature (dry bulb)	Hours	Heat demand	Heat load covered by the heatpump	Electrical back up heater capacity	COP_{bin} (Tj)	Net annual heating capacity	Net annual power input [a]
	j	T_j	h_j	$P_h(T_j)$		$elbu(T_j)$		$h_j \times (P_h(T_j) - elbu(T_j))$	
	-	°C	h	kW	kW	kW		kWh	kWh
F	21	−10	1	11,46	7,80	3,66	2,60	8	3
	22	−9	25	11,02	8,38	2,64	2,82	210	74
	23	−8	23	10,58	8,97	1,62	3,04	206	68
A	24	−7	24	10,14	9,55	0,59	3,26	229	70
E	25	−6	27	9,70	9,70	0,00	3,30	262	79
	26	−5	68	9,26	9,26	0,00	3,35	630	188
	27	−4	91	8,82	8,82	0,00	3,40	802	236
	28	−3	89	8,38	8,38	0,00	3,45	746	216
	29	−2	165	7,94	7,94	0,00	3,50	1 310	374
	30	−1	173	7,50	7,49	0,00	3,55	1 297	365
	31	0	240	7,05	7,05	0,00	3,60	1 693	470
	32	1	280	6,61	6,61	0,00	3,65	1 852	507
B	33	2	320	6,17	6,17	0,00	3,70	1 975	534
	34	3	357	5,73	5,73	0,00	3,77	2 046	543
	35	4	356	5,29	5,29	0,00	3,83	1 884	492
	36	5	303	4,85	4,85	0,00	3,90	1 470	377
	37	6	330	4,41	4,41	0,00	3,96	1 455	367
C	38	7	326	3,97	3,97	0,00	4,03	1 294	321
	39	8	348	3,53	3,53	0,00	3,87	1 227	318
	40	9	335	3,09	3,09	0,00	3,70	1 034	279
	41	10	315	2,65	2,64	0,00	3,54	833	236
	42	11	215	2,20	2,20	0,00	3,37	474	140
D	43	12	169	1,76	1,76	0,00	3,21	298	93
	44	13	151	1,32	1,32	0,00	3,05	200	66
	45	14	105	0,88	0,88	0,00	2,88	93	32
	46	15	74	0,44	0,43	0,00	2,72	33	12
							Σ = = >	**23 558**	**6 461**

$SCOP_{net}$ (Formula (15)) **3,65**

[a] Net annual power input is used to determine $SCOP_{net}$ and is calculated for each bin by multiplying the ratio of heat demand to COP with the number of hours of that BIN according to following formula:

Net annual power input with resistive heat = $h_j \times (P_h(T_j) - elbu(T_j))/COP_{bin}(T_j)$ (F.2)

Annex G
(informative)

Calculation example for $SCOP_{on}$ and $SCOP_{net}$ – Application to a fixed capacity brine-to-water heat pump used for medium temperature application

- $T_{designh}$:	−22 °C
- $T_{bivalent}$:	−14 °C
- Capacity of the unit at $T_{bivalent}$:	9,70 kW
- $P_{designh}$:	12,20 kW
- Declared capacity of the unit at $T_{designh}$:	9,56 kW
- Climate:	Colder
- Supplementaryheater	electric

From Table 14 in 5.5.4, the COP_{bin} can be determined for each part load ratio and indoor and outdoor heat exchanger conditions.

As the unit is cycling on/off to reach the required part load ratio at part load conditions A, B, C and D, the inlet temperature of the indoor heat exchanger has been determined according to 8.4.1 (Formula (21). See also Annex D-Adaption of water temperature for fixed capacity units.

Table G.1 — Data for SCOP

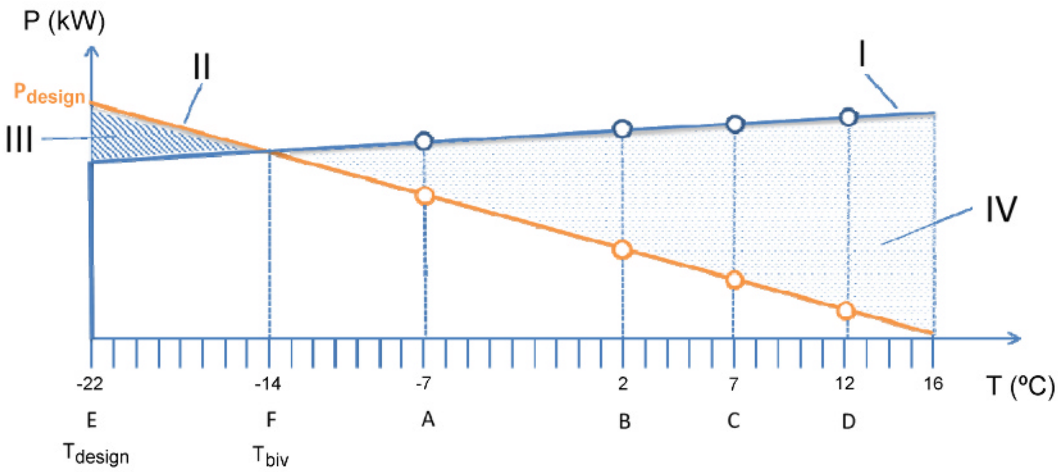
	Outdoor heat exchanger	Indoor heat exchanger	Part-load ratio	Part-load	Declared capacity	COP_d at declared capacity	P_E total Effective power input at Declared capacity	P_E Compressor off state effective power input	Cdh	CR[b]	COP at part load
	Brine	Outlet water temperature used for tests									
	Inlet/outlet temperatures										
	°C	°C	%	kW	kW	COP_d	kW	kW			COP_{bin}
A	0/[a]	46	61	**7,38**	9,83	3,63	2,71	0,01	1,00	0,75	**3,63**
B	0/[a]	42	37	**4,49**	10,06	4,07	2,47	0,01	1,00	0,45	**4,04**
C	0/[a]	38	24	**2,89**	10,25	4,48	2,29	0,01	0,99	0,28	**4,42**
D	0/[a]	36	11	**1,28**	10,38	4,82	2,15	0,01	0,99	0,12	**4,63**
E	0/[a]	55	100	**12,20**	9,56	2,98	3,20	0,01	1,00	1,00[c]	**2,98**
F	0/[a]	49	80	**9,70**	9,70	3,36	2,88	0,01	1,00	1,00	**3,36**

[a] With the brine flow rate as determined at the standard rating conditions of EN 14511–2, which are the 47/55 conditions.

[b] CR = part load divided by declared capacity.

[c] When the declared capacity is lower than the part load, the value of CR is considered to be equal to 1 and thus COP_{bin} is equal to COP_d.

The bold typed values are input values for the bin calculations. The corresponding values for the other bins are interpolated or extrapolated from the values presented in Table G.1.



Key

T	outdoor temperature (°C)
P	capacity/load (kW)
I	declared capacity line and declared capacities at conditions A, B, C and D
II	load curve and part load capacity at conditions A, B, C and D
III	electric back up heater
IV	on off cycling
T_{design}	reference design temperature
T_{biv}	bivalent temperature

Figure G.1 — Schematic overview of the $SCOP_{on}$ calculation points

Table G.2 — Calculation Bin for $SCOP_{on}$

	Bin	**Outdoor temperature (dry bulb)**	**Hours**	**Heat load**	**Heat load covered by HP**	**Electric back up heating**	**Annual electric back up heating**	**COP**	**Annual heating demand**	**Annual power input** including electric back up heating[a]
	j	**T_j**	**h_j**	**$P_h(T_j)$**		**elbu(T_j)**	**h_j × elbu(T_j)**		**h_j × $P_h(T_j)$**	
	-	°C	h	kW	kW	kW	kWh		kWh	kWh
E	9	−22	1	12,20	9,56	2,64	2,64	2,98	12	6
	10	−21	6	11,88	9,58	2,30	13,80	3,03	71	33
	11	−20	13	11,56	9,60	1,96	25,50	3,07	150	66
	12	−19	17	11,24	9,61	1,62	27,57	3,11	191	80
	13	−18	19	10,92	9,63	1,28	24,37	3,16	207	82
	14	−17	26	10,59	9,65	0,94	24,52	3,20	275	103
	15	−16	39	10,27	9,67	0,60	23,55	3,24	401	140
	16	−15	41	9,95	9,69	0,26	10,84	3,28	408	132
F	17	−14	35	9,63	9,63	0,00	0,00	3,33	337	101
	18	−13	52	9,31	9,31	0,00	0,00	3,37	484	144
	19	−12	37	8,99	8,99	0,00	0,00	3,41	333	97
	20	−11	41	8,67	8,67	0,00	0,00	3,46	355	103
	21	−10	43	8,35	8,35	0,00	0,00	3,50	359	103
	22	−9	54	8,03	8,03	0,00	0,00	3,54	433	122
	23	−8	90	7,71	7,71	0,00	0,00	3,59	693	193
A	24	−7	125	7,38	7,38	0,00	0,00	3,63	923	254
	25	−6	169	7,06	7,06	0,00	0,00	3,67	1 194	325
	26	−5	195	6,74	6,74	0,00	0,00	3,72	1 315	353
	27	−4	278	6,42	6,42	0,00	0,00	3,77	1 785	474
	28	−3	306	6,10	6,10	0,00	0,00	3,81	1 867	490
	29	−2	454	5,78	5,78	0,00	0,00	3,86	2 624	680
	30	−1	385	5,46	5,46	0,00	0,00	3,91	2 101	538
	31	0	490	5,14	5,14	0,00	0,00	3,95	2 517	637
	32	1	533	4,82	4,82	0,00	0,00	4,00	2 567	642
B	33	2	380	4,49	4,49	0,00	0,00	4,04	1 708	422
	34	3	228	4,17	4,17	0,00	0,00	4,12	952	231
	35	4	261	3,85	3,85	0,00	0,00	4,19	1 006	240
	36	5	279	3,53	3,53	0,00	0,00	4,27	985	231
	37	6	229	3,21	3,21	0,00	0,00	4,34	735	169
C	38	7	269	2,89	2,89	0,00	0,00	4,42	777	176
	39	8	233	2,57	2,57	0,00	0,00	4,46	598	134
	40	9	230	2,25	2,25	0,00	0,00	4,51	517	115
	41	10	243	1,93	1,93	0,00	0,00	4,55	468	103
	42	11	191	1,61	1,61	0,00	0,00	4,59	307	67
D	43	12	146	1,28	1,28	0,00	0,00	4,63	187	40
	44	13	150	0,96	0,96	0,00	0,00	4,68	144	31
	45	14	97	0,64	0,64	0,00	0,00	4,72	62	13
	46	15	61	0,32	0,32	0,00	0,00	4,76	20	4
	47	16	0	0	0	0	0,00	4,81	0	0
								Σ = = >	**30 070**	**7 875**
								$SCOP_{on}$ (Formula (14))		**3,82**

[a] Annual power input including electric back up heating is calculated for each bin by multiplying the ratio of heat demand to SCOP with the number of hours of that bin with inclusion of the back up heating according to following formula:

$$\text{Annual power input including electric back up heating} = h_j \times [(P_h(T_j) - elbu(T_j)) / COP_{bin}(T_j) + elbu(T_j)] \quad (G.1)$$

Table G.3 — Calculation Bin for $SCOP_{net}$

	Bin	Outdoor temperature (dry bulb)	Hours	Heat load	Heat load covered by HP	Electric back up heating	COP	Net annual heating demand	Net annual power input [a]
	j	Tj	hj	Ph(Tj)		elbu(Tj)		hj × (Ph(Tj)-elbu(Tj))	
	-	°C	h	kW	kW	kW		kWh	kWh
E	9	−22	1	12,20	9,56	2,64	2,98	10	3
	10	−21	6	11,88	9,58	2,30	3,03	57	19
	11	−20	13	11,56	9,60	1,96	3,07	125	41
	12	−19	17	11,24	9,61	1,62	3,11	163	53
	13	−18	19	10,92	9,63	1,28	3,16	183	58
	14	−17	26	10,59	9,65	0,94	3,20	251	78
	15	−16	39	10,27	9,67	0,60	3,24	377	116
	16	−15	41	9,95	9,69	0,26	3,28	397	121
F	17	−14	35	9,63	9,63	0,00	3,33	337	101
	18	−13	52	9,31	9,31	0,00	3,37	484	144
	19	−12	37	8,99	8,99	0,00	3,41	333	97
	20	−11	41	8,67	8,67	0,00	3,46	355	103
	21	−10	43	8,35	8,35	0,00	3,50	359	103
	22	−9	54	8,03	8,03	0,00	3,54	433	122
	23	−8	90	7,71	7,71	0,00	3,59	693	193
A	24	−7	125	7,38	7,38	0,00	3,63	923	254
	25	−6	169	7,06	7,06	0,00	3,67	1 194	325
	26	−5	195	6,74	6,74	0,00	3,72	1 315	353
	27	−4	278	6,42	6,42	0,00	3,77	1 785	474
	28	−3	306	6,10	6,10	0,00	3,81	1 867	490
	29	−2	454	5,78	5,78	0,00	3,86	2 624	680
	30	−1	385	5,46	5,46	0,00	3,91	2 101	538
	31	0	490	5,14	5,14	0,00	3,95	2 517	637
	32	1	533	4,82	4,82	0,00	4,00	2 567	642
B	33	2	380	4,49	4,49	0,00	4,04	1 708	422
	34	3	228	4,17	4,17	0,00	4,12	952	231
	35	4	261	3,85	3,85	0,00	4,19	1006	240
	36	5	279	3,53	3,53	0,00	4,27	985	231
	37	6	229	3,21	3,21	0,00	4,34	735	169
C	38	7	269	2,89	2,89	0,00	4,42	777	176
	39	8	233	2,57	2,57	0,00	4,46	598	134
	40	9	230	2,25	2,25	0,00	4,51	517	115
	41	10	243	1,93	1,93	0,00	4,55	468	103
	42	11	191	1,61	1,61	0,00	4,59	307	67
D	43	12	146	1,28	1,28	0,00	4,63	187	40
	44	13	150	0,96	0,96	0,00	4,68	144	31
	45	14	97	0,64	0,64	0,00	4,72	62	13
	46	15	61	0,32	0,32	0,00	4,76	20	4
	47	16	0	0	0	0	4,81	0	0
							Σ = = >	**29 917**	**7 722**

$SCOP_{net}$ (Formula (15))	**3,87**

[a] Net annual power input is used to determine $SCOP_{net}$ and is calculated for each bin by multiplying the ratio of heat demand to COP with the number of hours of that bin according to following formula:

Net annual power input without electric back up heating = hj × (Ph(Tj)-elbu(Tj))/ COPbin (Tj) (G2)

Annex H
(informative)

Compensation methods for air-to-water and water/brine-to-water units

H.1 General

This annex provides examples of compensation systems that can be used for the part load tests of air-to-water and water/brine-to-water units in cooling and heating mode.

H.2 Compensation system for reduced capacity test in cooling mode

The unit under test is installed in a closed test rig that includes:

— a variable resistance electrical heater, to compensate for the cooling capacity of the air-to-water unit,

— one or more storage tanks, for simulating the inertia of real applications (10 l/kW to 30 l/kW),

as described in Figure H.1.

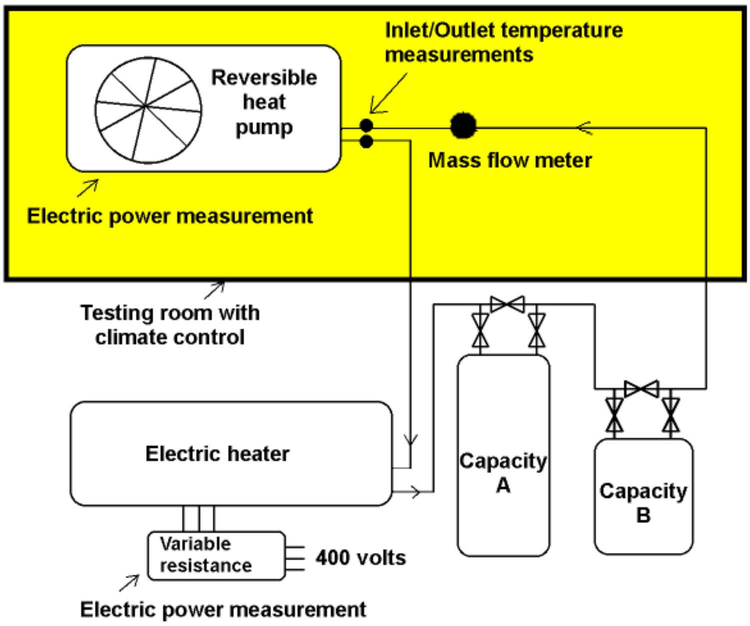


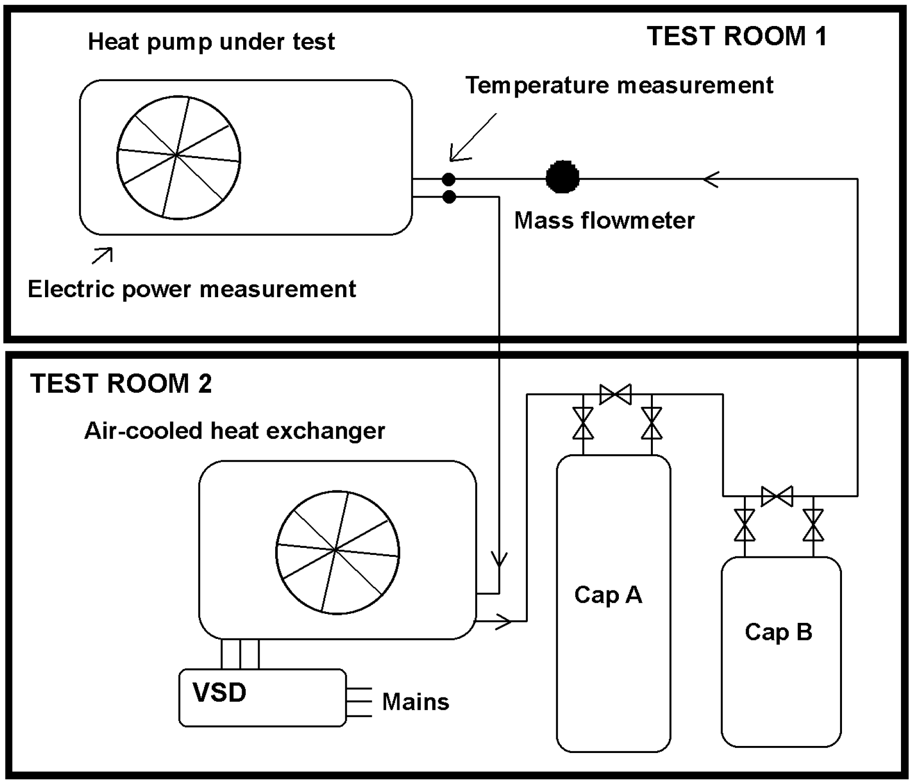
Figure H.1 — Test installation for part load testing cooling

The resistance of the electrical heater is set to provide the required part load ratio.

H.3 Compensation system for reduced capacity test in heating mode

The air-to-water unit is connected to an oversized fan-coil cooler installed in a second test room (see Figure H.2). If the cooler fan speed can be adjusted via frequency control, there are two means of controlling the heating duty: fan speed and room air temperature.

Water tanks in series can be added to the circuit to enable to simulate different circuit water capacities. These are represented by Cap A and Cap B in Figure H.2.



Key

VSD Variable Speed Device

Figure H.2 — Test installation for part load testing heating

The test shall be performed in accordance with EN 14511-3 considering the admissible deviations, uncertainties of measurement.

A sampling frequency of 15 s is required in order to have real-time measurement of the duties (heating capacity and electrical duty). Due to water temperature cycling during the test, the heating capacity and the electrical power input shall be obtained from a time-integration of the energy balance on several cycles.

Annex ZA
(informative)

Relationship between this European Standard and the requirements of Commission Regulation (EU) No 206/2012

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to requirements of *Commission Regulation (EU) No 206/2012 of 6 March 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans*.

Once this standard is cited in the Official Journal of the European Union under that Commission Regulation, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding requirements of that and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Commission Regulation (EU) No 206/2012

Clauses and subclauses of this EN	Requirements of Commission Regulation (EU) No 206/2012	Qualifying remarks/Notes
Clause 3	Annex I.1	
Not applicable	Annex I.2a Tables 1, 2, 3	Single ducts and double ducts are not in scope of this standard
Clause 6, Clause 7, 8.1, 8.2, 8.4.1, 8.4.2, 8.5.1, Clause 9, Annex A	Annex I.2b Table 4	
Not applicable	Annex I.2b Table 5	Sound power level is not covered by this standard
Clause 6, Clause 7, 8.1, 8.2, 8.4.1, 8.4.2, 8.5.1, Clause 9, Annex A	Annex I.2c Table 6	
Not applicable	Annex I.2d Table 7	Single ducts and double ducts are not in scope of this standard
Not applicable	Annex I.3 a	
8.5.1	Annex I.3 b	
Clause 11	Annex I.3 c	
Not applicable	Annex I.3 d	
Not applicable	Annex I.4 e	
Not applicable	Annex II.1	
6.4, 7.4	Annex II.2a	
4.2, 5.2, 8.5.1	Annex II.2b	
8.1, 8.2, 8.3, 8.4.1, 8.4.2, Clause 9, Annex A	Annex II.2c	
8.4.2	Annex II.2d	
7.4	Annex II.2e	
7.4	Annex II.2f	
Clause 11	Annex II.3	
Not applicable	Annex II.4	Single ducts and double ducts are not in scope of this standard
Clause 6, Clause 7	Annex II.5	
Not applicable	Annex II.6	Comfort fans are not in scope of this standard

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

Relationship between this European Standard and the requirements of Commission Regulation (EU) No 813/2013 and Commission Delegated Regulation (EU) No 811/2013

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to requirements of *Commission Regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters.*

Once this standard is cited in the Official Journal of the European Union under that Commission Regulation, compliance with the clauses of this standard given in Table ZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding requirements of that and associated EFTA regulations.

Table ZB.1 — Correspondence between this European Standard and Commission Regulation (EU) No 813/2013

Clauses and subclauses of this EN	Requirements of Commission Regulation (EU) No 813/2013	Qualifying remarks/Notes
Clause 3	Annex I (19) – (54)	Definitions related to heat pumps
	Annex II.1	Requirements for heat pumps
Not applicable	Annex II.2	Requirements for water heating
Not applicable	Annex II.3	Requirements for sound power level
Not applicable	Annex II.4	Requirements for emissions of nitrogen oxides
C.2	Annex II.5, Table 2	Requirements for product information
Clause 7 (Calculations) Clause 8, Clause 9 (Tests)	Annex III.1	Measurements and Calculations
Clause 11	Annex III.2	General conditions, Conversion coefficient,
7.1	Annex III.3	Seasonal space heating energy efficiency
Clause 7	Annex III.4	Seasonal space heating energy efficiency of heat pumps coefficient of performance energy ratio part load for heating supplementary capacity degradation of energy efficiency heat demand, heat consumption heater modes mode hours
Clause 5	Annex III.4, Table 4	Design conditions
Annex B, Table B.1	Annex III.4, Table 5	Climate conditions
Clause 7, Clause 8, Clause 9, Annex B	Annex IV	Market surveillance
Not applicable	Annex V	Benchmark

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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Table ZB.2 — Correspondence between this European Standard and Commission Delegated Regulation (EU) No 811/2013

Clauses and subclauses of this EN	Requirements of Commission Regulation (EU) No 811/2013	Qualifying remarks/Notes
Clause 3	Annex I	Definitions
Not applicable	Annex II	Energy efficiency classes
Not applicable	Annex III	Labels
Not applicable	Annex IV	Product fiche
C.2	Annex V	Technical documentation
Not applicable	Annex VI	Information to be provided in cases where end-users cannot be expected to see the product displayed
Clause 7 (Calculations) Clause 8, Clause 9 (Tests)	Annex VII.1	Measurements and Calculations
Clause 11	Annex VII.2	General conditions,
Not applicable	Annex VII.3	Seasonal space heating energy efficiency
Clause 7	Annex VII.4	Seasonal space heating energy efficiency of and consumption of heat pumps and heat pump combination heaters
Not applicable	Annex VII.5	Water heating
Not applicable	Annex VII.6	Solar devices
Clause 5	Annex VII, Table 9	Standard rating conditions
Clause 5	Annex VII, Table 10	Reference design conditions
B.1	Annex VII, Table 12	European reference heating season under average, colder and warmer climate conditions for heat pump space heaters and heat pump combination heaters
Clause 7, Clause 8, Clause 9, Annex B	Annex VIII	Market surveillance

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

EN 14511-4, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 4: Operating requirements, marking and instructions*

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