SLOVENSKI STANDARD
SIST EN 14825:2012

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Nadomešča:
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Klimatske naprave, enote za tekočinsko hlajenje in toplotne črpalke z električnimi kompresorji za segrevanje in hlajenje prostora - Preskušanje in ocenitev ob delni obremenitvi ter izračun letnega učinka

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

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

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

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27.080	Toplotne črpalke	Heat pumps
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EUROPEAN STANDARD

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English Version

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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This European Standard was approved by CEN on 14 January 2012.

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

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Foreword

This document (EN 14825:2012) 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of an identical text or by endorsement, at the latest by September 2012, and conflicting national standards shall be withdrawn at the latest by September 2012.

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 CEN/TS 14825:2003.

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Introduction

Heat pumps, air conditioners and liquid chilling packages are, at present, selected and compared at a rated condition. 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 crank case heater or when the unit is on standby. These consumptions are considered in the calculation methods for reference SEER and reference SCOP.

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

The rating conditions and test methods of units operating at rated and application capacities are given in EN 14511-2 and EN 14511-3:2011.

The methods for calculation of system energy efficiencies for specific heat pump systems in buildings are given in EN 15316-4-2.

1 Scope

This European Standard covers air conditioners, heat pumps and liquid chilling packages. It applies to factory made units defined in EN 14511-1:2011, except single duct, control cabinet and close control units.

This European Standard gives the calculation methods for the determination of reference seasonal energy efficiency SEER and $SEER_{on}$ and reference seasonal coefficient of performance SCOP, $SCOP_{on}$ and $SCOP_{net}$.

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 and crankcase heater mode.

This European Standard serves as an input for the calculation of the system energy efficiency in heating mode of specific heat pump systems in buildings, as stipulated in the standard EN 15316-4-2.

2 Normative references

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

EN 14511-1:2011, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling — Part 1: Terms and definitions*

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 14511-3:2011, *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 14511-1:2011 (unless otherwise stated) and the following apply.

3.1.1
reference design conditions for cooling
Tdesignc
temperature conditions at 35 ºC dry bulb (24 ºC wet bulb) outdoor temperature and 27 ºC dry bulb (19 ºC wet bulb) indoor temperature

3.1.2
reference design conditions for heating
Tdesignh
temperature conditions for average, colder and warmer climates

Note 1 to entry: average = -10˚C, colder = -22˚C, warmer = 2˚C

3.1.3
full load
Pdesign
cooling (Pdesignc) or heating (Pdesignh) load of the building at Tdesign 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 Pdesign value.

Note 2 to entry: Expressed in kW.

3.1.4
part load
cooling or heating load of the building which is less than the full load

3.1.5
part load ratio
part load or full load divided by the full load

Note 1 to entry: If 100 % part load ratio is mentioned, this equals full load.

3.1.6
declared capacity
DC
cooling (or heating) capacity a unit can deliver at any temperature condition A, B, C, D, E or F, as declared by the manufacturer

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

Note 2 to entry: The temperature conditions for part load conditions A, B, C, D, E or F are explained in the tables.

3.1.7
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

3.1.8
reference cooling season
representative climate profile by temperature bins for cooling corresponding to the reference design conditions for cooling

Note 1 to entry: The climate profile for cooling is explained in Table 36.

3.1.9
reference heating season(s)
representative climate profile(s) by temperature bins for heating corresponding to the reference design conditions for heating

Note 1 to entry: There are three reference heating seasons: “A” average, “C” colder and “W” warmer. The climate profiles for heating are explained in Table 37.

3.1.10
bin hours
h_j
sum of all hours occurring at a given temperature for a specific location

Note 1 to entry: The number is rounded to a whole number and is derived from representative weather data over the 1982-1999 period.

Note 2 to entry: For the reference heating seasons the specific locations are Strasbourg (average), Helsinki (colder) and Athens (warmer).

3.1.11
bivalent temperature
Tbivalent
lowest outdoor temperature point at which the heat pump is declared to have a capacity able to meet 100 % of the heating capacity demand

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 capacity demand.

3.1.12
operation limit temperature
TOL
lowest outdoor temperature at which the heat pump can still deliver heating capacity, as declared by the manufacturer

3.1.13
reference annual cooling demand
Qc
representative annual cooling demand which is used for the calculation of reference SEER

Note 1 to entry: For certain types of units, Qce is calculated by multiplying the full load value in cooling (Pdesignc) by the number of equivalent cooling hours. This is explained in Annex D.

Note 2 to entry: The representative annual cooling demand is based on an estimated average use pattern. This is explained in Annex D.

Note 3 to entry: Expressed in kWh.

3.1.14
reference annual heating demand(s)
Qh
representative annual heating demand(s) which are used for the calculation of reference SCOP

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: For certain types of units, Qh is calculated by multiplying the full load value in heating (Pdesignh) by the number of equivalent heating hours. This is explained in Annex D.

Note 3 to entry: The representative annual heating demand is based on an estimated average use pattern. This is explained in Annex D.

Note 4 to entry: Expressed in kWh.

3.1.15
energy efficiency ratio at declared capacity
EER_{DC}
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, see Tables 2 to 5.

3.1.16
energy efficiency ratio at part load
EER_{PL}
cooling capacity at part load or full load conditions divided by the effective power input of a unit at specific temperature conditions

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

Note 2 to entry: Expressed in kW/kW.

3.1.17
coefficient of performance at declared capacity
COP_{DC}
declared heating capacity of the unit divided by the effective power input of a unit at specific temperature conditions, A, B, C, D, E and F, where applicable.

Note 1 to entry: Expressed in kW/kW.

3.1.18
coefficient of performance at part load
COP_{PL}
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.

3.1.19
seasonal energy efficiency ratio
SEER
seasonal efficiency of a unit calculated for the reference annual cooling demand, which is determined from mandatory conditions given in this European Standard and used for marking, comparison and certification purposes

Note 1 to entry: For calculation of SEER, the electricity consumption of a unit is used, including the electricity consumption during active mode, thermostat off mode, standby mode and that of the crankcase heater.

Note 2 to entry: Expressed in kWh/kWh.

3.1.20
active mode energy efficiency ratio
$SEER_{on}$
seasonal efficiency of a unit in active cooling mode which is determined from mandatory conditions given in this European Standard and used for marking, comparison and certification purposes

Note 1 to entry: For calculation of $SEER_{on}$, the electricity consumption during active mode is used. This excludes the power consumption during thermostat off mode, standby mode or that of the crank case heater.

Note 2 to entry: Expressed in kWh/kWh.

3.1.21
seasonal coefficient of performance
SCOP
seasonal efficiency of a unit calculated for the reference annual heating demand(s), which is determined from mandatory conditions given in this European Standard and used for marking, comparison and certification purposes

Note 1 to entry: For calculation of SCOP, the electricity consumption of a unit is used, including the power consumption during active mode, thermostat off mode, standby mode, that of the crankcase heater and where required that of an additional electric back up heater, regardless whether this back up heater is included in the unit or not.

Note 2 to entry: Expressed in kWh/kWh.

3.1.22
active mode coefficient of performance
$SCOP_{on}$

seasonal efficiency of a unit in active heating mode which is determined from mandatory conditions given in this European Standard and used for marking, comparison and certification purposes

Note 1 to entry: For calculation of $SCOP_{on}$, the electricity consumption during active mode is used. This excludes the power consumption during thermostat off mode, standby mode or that of the crank case heater. The power consumption of an electric back up 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.

3.1.23
Net seasonal coefficient of performance
$SCOP_{net}$
seasonal efficiency of a unit in active heating mode without supplementary electric heaters which is determined from mandatory conditions given in this European Standard and used for marking, comparison and certification purposes

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 or that of the crank case heater. For the part load conditions where the declared capacity of the unit is lower than the heating load, the power consumption of a back up heater is not included.

Note 2 to entry: Expressed in kWh/kWh.

3.1.24
electric back up heater
elbu
supplementary electric heater, with a COP of 1, considered in the calculation of SCOP and SCOPon, regardless of whether this is supplied together with the unit

3.1.25
application SEER and application $SEER_{on}$
SEER and $SEER_{on}$ that takes into account the specific application and the specific location of the unit, which are different from the ones used for determining the reference SEER and reference $SEER_{on}$ 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 reference $SEER_{on}$. 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.

3.1.26
application SCOP, application $SCOP_{on}$ and $SCOP_{net}$
SCOP and $SCOP_{on}$/$SCOP_{net}$ that takes into account the specific application and the specific location of the unit, which are different from the ones used for determining the reference SCOP and reference $SCOP_{on}$ / $SCOP_{net}$ 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 reference $SCOP_{on}$/$SCOP_{net}$. 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.

3.1.27
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 switched on

Note 1 to entry: The unit has to reach or maintain a temperature set point and in order to do so, the unit may switch between being operational or not operational (e.g. by on/off cycling of the compressor).

3.1.28
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: For the reference cooling season, this situation occurs when the outdoor temperature reaches 16 °C or lower. For the reference heating seasons, this situation occurs when the outdoor temperature reaches 16 °C or higher.

Note 2 to entry: When a unit is cycling off during active mode, this is not considered as thermostat off mode.

3.1.29
standby mode
mode wherein the unit is switched off partially and can be reactivated by a control device or timer

Note 1 to entry: The unit is connected to the mains power source, 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.

3.1.30
off mode
mode wherein the unit is completely switched off and can be reactivated neither by control device nor by timer

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

3.1.31
crankcase heater hours
mode corresponding to the hours where a crankcase heater is activated

Note 1 to entry: The function of the crankcase heater is to avoid refrigerant to migrate to the compressor to limit refrigerant concentration in oil at compressor start.

3.1.32
capacity control
ability of the unit to change its capacity by changing the refrigerant volumetric flow rate

Note 1 to entry: Units are to be indicated as ‘fixed’ if the unit cannot change its capacity, or as 'variable' if the capacity is changed or varied in series of two or more steps or increments.

3.1.33
degradation coefficient
Cc
measure of efficiency loss due to the cycling of air-to-water or water/brine-to-water units

3.1.34
degradation coefficient
Cd
measure of efficiency loss due to the cycling of air-to-air or water/brine-to-air units

3.1.35
compensation load
heating or cooling load imposed by the test apparatus on the test object

3.1.36
fixed outlet
control of the heat pump has no means to vary the water flow temperature with the outdoor air temperature

3.1.37
variable outlet
control of the heat pump has means to vary the water flow temperature with the outdoor air temperature

3.1.38
forced convection air-cooled liquid cooler
“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)

3.2 Symbols, abbreviated terms and units

Table 1 — Symbols, abbreviated terms and units *(1 of 2)*

Symbol and abbreviated terms	Denomination	Units
A	Average Climate	—
C	Colder Climate	—
Cc	Degradation Coefficient for air-to-water or water/brine units	—
Cd	Degradation Coefficient for air-to-air or water/brine-to-air units	—
COP_{DC}	Coefficient of Performance at the declared capacity	kW/kW
COP_{PL}	Coefficient of Performance at Part $Load_{Tj}$	kW/kW
COP(Tj)	Coefficient of Performance at the corresponding Bin Temperature	kW/kW
CR	Capacity Ratio	kW/kW
DC	Declared Capacity	kW
EER_{DC}	Energy Efficiency Ratio at the Declared Capacity	kW/kW
EER_{PL}	Energy Efficiency Ratio at Part Load	kW/kW
EER(Tj)	Energy Efficiency Ratio at the corresponding Bin Temperature	kW/kW
elbu	Electric Back Up Heater	kW