SLOVENSKI STANDARD
SIST EN 14511-3:2018

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Klimatske naprave, enote za hlajenje kapljevine, toplotne črpalke za ogrevanje in hlajenje prostora ter procesne hladilne naprave z električnimi kompresorji - 3. del: Preskusne metode

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

Luftkonditionierer, Flüssigkeitskühlsätze und Wärmepumpen für die Raumbeheizung und -kühlung und Prozess-Kühler mit elektrisch angetriebenen Verdichtern - Teil 3: Prüfverfahren

Climatiseurs, groupes refroidisseurs de liquide et pompes à chaleur pour le chauffage et le refroidissement des locaux et refroidisseurs industriels avec compresseur entraîné par moteur électrique - Partie 3: Méthodes d'essai

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27.080	Toplotne črpalke	Heat pumps
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EUROPEAN STANDARD

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

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This European Standard was approved by CEN on 31 December 2017.

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

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European foreword

This document (EN 14511-3:2018) has been prepared by Technical Committee CEN/TC 113 “Heat pumps and air conditioning units”, the secretariat of which is held by UNE.

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of an identical text or by endorsement, at the latest by September 2018, and conflicting national standards shall be withdrawn at the latest by March 2021.

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

This document supersedes EN 14511-3:2013.

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 Regulation No 206/2012 and EU Regulation No 626/2011.

For relationship with EU Regulation No 206/2012 and EU Regulation No 626/2011, see informative Annexes ZA and ZB, which are an integral part of this document.

The main changes with respect to the previous edition are listed below:

a) the revision of Annexes A and B on the test methods;

b) deletion of Annex C;

c) the revision of Annex G (Annex H on the previous version) on liquid pumps corrections;

d) the inclusion of process chillers into the scope of the EN 14511 series and of this Part 3.

Although this document has been 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 is also intended to support the Essential Requirements of the European Directive 2010/30/EU.

EN 14511 currently comprises the following parts:

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

— *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 2: Test conditions,*

— *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 3: Test methods,*

— *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 4: Requirements.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

1.1 The scope of EN 14511-1 is applicable.

1.2 This European Standard specifies the test methods for the rating and performance of air conditioners, liquid chilling packages and heat pumps using either air, water or brine as heat transfer media, with electrically driven compressors when used for space heating and cooling. These test methods also apply for the rating and performance of process chillers.

It also specifies the method of testing and reporting for heat recovery capacities, system reduced capacities and the capacity of individual indoor units of multisplit systems, where applicable.

This European Standard also makes possible to rate multisplit and modular heat recovery multisplit systems by rating separately the indoor and outdoor units.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14511-1:2018, *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 1: Terms and definitions*

EN 14511-2:2018, *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 2: Test conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14511-1:2018 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

4 Tests for determination of capacities

4.1 Basic principles, method of calculation for the determination of capacities

4.1.1 Heating capacity

The heating capacity of air conditioners and of air-to-air or water(brine)-to-air heat pumps shall be determined by measurements in a calorimeter room (see Annex A) or by the air enthalpy method (see Annex B).

However, the heating capacity of air conditioners and of air-to-air heat pumps having a capacity below or equal to 12 kW for cooling, or heating if the unit has no cooling function, under the standard rating conditions of EN 14511-2 shall be determined by measurements in a calorimeter room.

For heating only units the limit of 12 kW applies to the heating capacity as given under the standard rating conditions of EN 14511-2.

When using the air enthalpy method, in steady-state operation, the heating capacity shall be determined using the following formula:

$$P_H = q \times \rho \times c_p \times \Delta T \quad (1)$$

where

P_H is the heating capacity, expressed in W;

q is the air volume flow rate as measured during the test, expressed in m^3/s;

ρ is the air density as measured during the test, expressed in kg/ m^3;

c_p is the specific heat at constant pressure, expressed in J/(kg.K);

ΔT is the difference between outlet and inlet temperatures, expressed in K.

The air density shall be determined for the air conditions at the air flow measuring device.

NOTE 1 The mass flow rate can directly be determined instead of the term (q x ρ).

NOTE 2 The enthalpy change ΔH can directly be used instead of the term (c_p x ΔT).

For the heating capacity calculation in transient operation, refer to 4.5.3.2.

The heating capacity of air-to-water(brine), water(brine)-to-water(brine) heat pumps and liquid chilling packages shall be determined in accordance with the direct method at the water or brine heat exchanger, by determination of the volume flow of the heat transfer medium, and the inlet and outlet temperatures, taking into consideration the specific heat capacity and density of the heat transfer medium.

The measured heating capacity of air-to-air and water(brine)-to-air units shall be corrected for the heat from the indoor fan as specified in 4.1.4.1 or 4.1.4.2.

The measured heating capacity of water(brine)-to-water(brine) and air-to-water(brine)units shall be corrected for the heat from the indoor liquid pump as specified in 4.1.4.3.

4.1.2 Cooling capacity

The cooling capacity of air conditioners and of air-to-air or water(brine)-to-air heat pumps shall be determined by measurements in a calorimeter room (see Annex A) or by the air enthalpy method (see Annex B).

However, air conditioners and of air-to-air heat pumps having a cooling capacity below or equal to 12 kW under the standard rating conditions given in EN 14511-2, shall be tested using a calorimeter room.

When using the air enthalpy method, the cooling capacity shall be determined using the following formula:

$$P_C = q \times \rho \times c_p \times \Delta T \quad (2)$$

where

P_C is the cooling capacity, expressed in W;

q is the air volume flow rate as measured during the test, expressed in m^3/s;

ρ is the air density as measured during the test, expressed in kg/m^3;

c_p is the specific heat at constant pressure, expressed in J/(kg.K);

ΔT is the difference between inlet and outlet temperatures, expressed in K.

The air density shall be determined for the air conditions at the air flow measuring device.

NOTE 1 The mass flow rate can directly be determined instead of the term (q x ρ).

NOTE 2 The enthalpy change ΔH can directly be used instead of the term (c_p x ΔT).

The cooling capacity of air-to-water(brine), water(brine)-to-water(brine) heat pumps and liquid chilling packages shall be determined in accordance with the direct method at the water or brine heat exchanger, by determination of the volume flow of the heat transfer medium, and the inlet and outlet temperatures, taking into consideration the specific heat capacity and density of the heat transfer medium.

The measured cooling capacity of air-to-air and water(brine)-to-air units shall be corrected for the heat from the indoor fan as specified in 4.1.4.1 or 4.1.4.2.

The measured cooling capacity of water(brine)-to-water(brine) and air-to-water(brine) units shall be corrected for the heat from the indoor liquid pump as specified in 4.1.4.3

4.1.3 Heat recovery capacity

The heat recovery capacity of air-to-water(brine), water(brine)-to-water(brine) heat pumps and liquid chilling packages shall be determined in accordance with the direct method at the water or brine heat recovery heat exchanger, by determination of the volume flow of the heat transfer medium, and the inlet and outlet temperatures, taking into consideration the specific heat capacity and density of the heat transfer medium.

The heat recovery capacity shall be determined using the following formula:

$$P_{HR} = q \times \rho \times c_p \times \Delta T \quad (3)$$

where

P_{HR} is the heat recovery capacity, expressed in W;

q is the volume flow rate, expressed in m^3/s ;

ρ is the density, expressed in kg/m^3;

c_p is the specific heat at constant pressure, expressed in J/(kg.K);

ΔT is the difference between outlet and inlet temperatures expressed in K.

NOTE 1 The mass flow rate can directly be determined instead of the term (q x ρ).

NOTE 2 The enthalpy change ΔH can directly be used instead of the term (c_p x ΔT).

The measured heat recovery capacity of units shall be corrected for the heat from the liquid pump as specified in 4.1.4.3.

4.1.4 Capacity correction

4.1.4.1 General

The capacity shall include the correction due to the heat output of indoor and/or outdoor fans and/or pumps, integrated into the unit or not as follows.

4.1.4.2 Capacity correction of fans for units without duct connection

In the case of units which are not designed for duct connection, i.e. which do not permit any external pressure difference, and which are equipped with an integral fan, no capacity correction due to heat provide by the fan shall apply.

4.1.4.3 Capacity correction due to indoor fan for ducted units

4.1.4.3.1 Units with integrated indoor fan

If the fan at the indoor heat exchanger is an integral part of the unit, the power input correction of the fan, as calculated with Formula (8) (see 4.1.5.3.1) shall be:

— subtracted from the measured heating capacity

— added to the measured cooling capacity

4.1.4.3.2 Units with non-integrated indoor fan

If the fan at the indoor heat exchanger is not an integral part of the unit, the power input correction as calculated with Formula (9) (see 4.1.5.3.2) shall be:

— added to the measured heating capacity

— subtracted from the measured cooling capacity

4.1.4.4 Capacity correction due to indoor liquid pump

4.1.4.4.1 Units with integrated liquid pump

If the liquid pump is an integrated part of the unit, the capacity correction as defined in 4.1.4.4.3 or 4.1.4.4.4 shall be:

— subtracted from the measured heating capacity.

— added to the measured cooling capacity

— subtracted from the measured heat recovery capacity

4.1.4.4.2 Units with non-integrated liquid pump

If the liquid pump is not an integral part of the unit, the capacity correction as defined in 4.1.4.4.5 shall be:

— added to the measured heating capacity.

— subtracted from the measured cooling capacity

— added to the measured heat recovery capacity

4.1.4.4.3 Capacity correction for integrated glandless circulators

If the unit is equipped with a glandless circulator, the capacity correction is calculated using formula (4

$$(q \times \Delta p_e) \times [(1-\eta)/\eta] \quad (4)$$

where

q is the measured liquid flow rate, expressed in m³/s.

Δp_e is the measured available external static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.58;

η is the global efficiency of the pump calculated according to Annex G.

4.1.4.4.4 Capacity correction for integrated dry motor pumps

If the unit is equipped with a dry-motor pump, the capacity correction shall be calculated using Formula (5).

$$(q \times \Delta p_e) \times [(IE - \eta)/\eta] \quad (5)$$

where

q is the measured liquid volume flow rate, expressed in m³/s;

Δp_e is the measured available external static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.58;

IE is the motor efficiency level as defined in the EC No 640/2009 regulation;

η is the global efficiency of the pump calculated according to Annex G.

4.1.4.4.5 Capacity correction for non-integrated liquid pumps

If the measured hydraulic power according to Annex G is ≤ 300 W, the liquid pump is considered as a glandless circulator. The capacity correction is calculated using Formula (6).

$$(q \times (-\Delta p_i)) \times [(1-\eta)/\eta] \quad (6)$$

where

q is the measured liquid flow rate, expressed in m³/s;

Δp_i is the measured internal static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.59;

η is the global efficiency of the pump calculated according to Annex G.

If the measured hydraulic power according to Annex G is > 300 W, the liquid pump is considered as a dry-motor pump. The capacity correction is calculated using Formula (7).

$$[q \times (-\Delta p_i)] \times [(IE - \eta) /\eta)] \quad (7)$$

where

q is the liquid volume flow rate, expressed in m³/s;

Δp_i is the measured internal static pressure difference, expressed in Pascal, as defined in 3.59 of EN 14511-1:2018;

IE is equal to 0,88 (the average the motor efficiency level defined in the EC No 640/2009 regulation for IE3 efficiency level);

η is the global efficiency of the pump calculated according to Annex G.

4.1.5 Effective power input

4.1.5.1 General

The effective power input shall include the correction due to power input of indoor and/or outdoor fans and/or pumps, integrated or no to the unit as follows.

4.1.5.2 Power input correction of fans for units without duct connection

In the case of units which are not designed for duct connection, i.e. which do not permit any external pressure differences, and which are equipped with an integral fan, the power absorbed by the fan shall be included in the effective power absorbed by the unit.

4.1.5.3 Power input correction of fans for units with duct connection

4.1.5.3.1 Power input correction for integrated fans

If a fan is an integral part of the unit, only a fraction of the power input of the fan motor shall be included in the effective power absorbed by the unit. The fraction that is to be excluded from the total power absorbed by the unit shall be calculated using Formula (8):

$$\frac{q \times \Delta p_{e(corr)}}{\eta} \quad (8)$$

where

q is the air volume flow rate, expressed in m^3/s and set according to 4.4.1.3 or 4.4.1.4;

$\Delta p_{e\,(corr)}$ is the available external static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.58 and set according to 4.4.1.3 or 4.4.1.4;

η is equal to η_{target} as declared by the fan manufacturer according to the ecodesign regulation n°327/2011 for fans driven by motors between 125 W and 500 kW; otherwise is equal to 0,3 by convention.

4.1.5.3.2 Power input correction for non-integrated fans

If no fan is provided with the unit, the proportional power input which is to be included in the effective power absorbed by the unit shall be calculated using the Formula (9):

$$\frac{q \times \left(-\Delta p_i\right)}{\eta} \quad (9)$$

where

q is the air volume flow rate, expressed in m^3/s and set according to 4.4.1.3 or 4.4.1.4;

Δp_i is the measured internal static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.59;

η is 0,3 by convention.

4.1.5.4 Power input correction of liquid pumps

4.1.5.4.1 Power input correction for integrated liquid pumps

When the liquid pump is integrated into the unit, it shall be connected for operation. When the liquid pump is delivered by the manufacturer apart from the unit, it shall be connected for operation according to the manufacturer's instructions and be then considered as an integral part of the unit.

For an integrated liquid pump, only a fraction of the input to the pump motor shall be included in the effective power absorbed by the unit. The fraction which is to be excluded from the total power absorbed by the unit shall be calculated using Formula (10):

$$\frac{q \times \Delta p_e}{\eta} \qquad (10)$$

where

q is the measured liquid flow rate, expressed in m^3/s;

Δp_e is the measured available external static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.58;

η is the efficiency of the pump calculated according to Annex G.

In case the liquid pump is not able to provide any external static pressure difference, then this correction does not apply but the correction shall be made according to 4.1.5.4.2.

4.1.5.4.2 Power input correction for non-integrated liquid pumps

If no liquid pump is provided with the unit, the proportional power input which is to be included in the effective power absorbed by the unit shall be calculated using Formula (11):

$$\frac{q \times \left(-\Delta p_i\right)}{\eta} \qquad (11)$$

where

q is the measured liquid flow rate, expressed in m^3/s;

Δp_i is the measured internal static pressure difference, expressed in Pa, as defined in EN 14511–1:2018, 3.59;

η is the efficiency of the pump calculated according to Annex G.

4.1.6 Units on a distribution network of pressured water

In the case of appliances designed especially to operate on a distributing network of pressurized water without water-pump, no correction shall be applied to the power input.

4.1.7 Units for use with remote condenser

The power from the auxiliary liquid pump of the remote condenser shall not be taken into account in the effective power input.