SLOVENSKI STANDARD

oSIST prEN 14511-3:2015

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Klimatske naprave, enote za tekočinsko hlajenje in toplotne črpalke za ogrevanje in hlajenje prostora in električni kompresorji za ogrevanje in hlajenje prostora - 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

Ta slovenski standard je istoveten z: **prEN 14511-3**

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27.080	Toplotne črpalke	Heat pumps
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EUROPEAN STANDARD

NORME EUROPÉENNE

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English Version

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

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 113.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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European foreword

This document (prEN 14511-3:2015) has been prepared by Technical Committee CEN/TC 113 “Heat pumps and air conditioning units”, the secretariat of which is held by AENOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede 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.

For relationship with EU Regulation No 206/2012, see informative Annex ZA, which is 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) the revision of Annex H on liquid pumps corrections;

c) 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.

prEN 14511 currently comprises the following parts:

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

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

1 Scope

1.1 The scope of prEN 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, 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.

prEN 14511-1:2015, *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 1: Terms, definitions and classification*

prEN 14511-2:2015, *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 prEN 14511-1:2015 apply.

4 Rating capacity test

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 cooling capacity below or equal to 12 kW shall be determined by measurements in a calorimeter room.

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.

For 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 heat capacity, expressed in Watts;

q is the volume flow rate, expressed in cubic metres per second;

ρ is the density, expressed in kilograms per cubic metre;

c_p is the specific heat at constant pressure, expressed in joules per kilogram and Kelvin;

Δt is the difference between inlet and outlet temperatures, expressed in Kelvin.

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

NOTE 2 The enthalpy change ΔH can be directly measured instead of the term (cp x Δt).

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

The heating capacity shall be corrected for the heat from the fan or pump:

a) if the fan or pump at the indoor heat exchanger is an integral part of the unit, the same power (calculated in 4.1.5.2 or 4.1.6.3) which is excluded from the total power input shall be also subtracted from the heating capacity;

b) if the fan or pump at the indoor heat exchanger is not an integral part of the unit, the same power (calculated in 4.1.5.3 or 4.1.6.4) which is included in the effective power input shall be also added to the heating capacity.

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, the cooling capacity of air conditioners and of air-to-air heat pumps having a cooling capacity below or equal to 12 kW shall be determined by measurements in a calorimeter room.

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 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 watts;

q is the volume flow rate, expressed in cubic metres per second;

ρ is the density, expressed in kilograms per cubic metre;

c_p is the specific heat at constant pressure, expressed in joules per kilogram and Kelvin;

Δt is the difference between inlet and outlet temperatures, expressed in Kelvin.

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

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

The cooling capacity shall be corrected for the heat from the fan or pump:

a) If the fan or pump at the evaporator is an integral part of the unit, the same power (calculated in 4.1.5.2 or 4.1.6.3) which is excluded from the total power input is also added to the cooling capacity.

b) If the fan or pump at the evaporator is not an integral part of the unit, the same power (calculated in 4.1.5.3 or 4.1.6.4) which is included in the effective power input is also subtracted from the cooling capacity.

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 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:

$$P_{HR} = q \times \rho \times c_p \times \Delta t \qquad (3)$$

where

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

q is the volume flow rate, expressed in cubic metres per second;

ρ is the density, expressed in kilograms per cubic metre;

c_p is the specific heat at constant pressure, expressed in joules per kilogram and Kelvin;

Δt is the difference between inlet and outlet temperatures expressed in Kelvin.

NOTE The mass flow rate can be determined directly instead of the term (q x ρ). The enthalpy change ΔH can be directly measured instead of the term (c_p x Δt).

The heat recovery capacity shall be corrected for the heat of the pump:

a) if the pump at the heat recovery exchanger is an integral part of the unit, the power calculated according to 4.1.6.3 shall be subtracted from heat recovery capacity

b) if the pump at the heat recovery exchanger is not an integral part of the unit, the power calculated according to 4.1.6.4 shall be added to the heat recovery capacity.

4.1.4 Power input 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 Power input of fans for units with duct connection

4.1.5.1 The following corrections of the power input of fans shall be made to both indoor and outdoor fans, where applicable.

4.1.5.2 If a fan is an integral part of the unit, only a fraction of the 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 the following formula:

$$\frac{q.\Delta p_e}{\eta} \qquad (4)$$

where

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;

η is 0,3 by convention, for fans driven by motors below 125 W;

Δp_e is the available external static pressure difference, expressed in Pascal, as defined in prEN 14511–1:2015, 2.59 and set according to 4.4.1.3 or 4.4.1.4;

q is the air flow rate, expressed in cubic meters per second and set according to 4.4.1.3 or 4.4.1.4.

4.1.5.3 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 following formula:

$$\frac{q.(-\Delta p_i)}{\eta} \qquad (5)$$

where

η is 0,3 by convention;

Δp_i is the measured internal static pressure difference, expressed in Pascal, as defined in prEN 14511–1:2015, 2.60;

q is the air flow rate, expressed in cubic meters per second and set according to 4.4.1.3 or 4.4.1.4.

4.1.6 Power input of liquid pumps

4.1.6.1 The following corrections of the power input of liquid pumps shall be made to both indoor and outdoor (and heat recovery) liquid pumps, where applicable.

4.1.6.2 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.

4.1.6.3 If a liquid pump is an integral part of the unit, 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 the following formula:

$$\frac{q \times \Delta p_e}{\eta} \qquad (6)$$

where

η is the efficiency of the pump calculated according to Annex H;

Δp_e is the measured available external static pressure difference, expressed in Pascal, as defined in prEN 14511–1:2015, 2.59;

q is the measured liquid flow rate, expressed in cubic meters per second.

In case the liquid pump is not able to provide any external static pressure difference, then the correction does not apply but the correction shall be made according to 4.1.6.4.

4.1.6.4 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 the following formula:

$$\frac{q \times (-\Delta p_i)}{\eta} \quad (7)$$

where

η is the efficiency of the pump calculated according to Annex H;

Δp_i is the measured internal static pressure difference, expressed in Pascal, as defined in prEN 14511–1:2015, 2.60;

q is the measured liquid flow rate, expressed in cubic meters per second.

4.1.6.5 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.

4.2 Test apparatus

4.2.1 Arrangement of the test apparatus

4.2.1.1 General requirements

The test apparatus shall be designed in such a way that all requirements on adjustment of set values, stability criteria and uncertainties of measurement according to this European Standard can be fulfilled.

4.2.1.2 Test room for the air side

The size of the test room shall be selected such that any resistance to air flow at the air inlet and air outlet orifices of the test object is avoided. The air flow through the room shall not be capable of initiating any short circuit between these two orifices, and therefore the velocity of the air flows through the room at these two locations shall not exceed 1,5 m/s when the test object is switched off. The air velocity in the room shall also not be greater than the mean velocity through the unit inlet. Unless otherwise stated by the manufacturer, the air inlet or air outlet orifices shall be not less than 1 m distant from the surfaces of the test room.

Any direct heat radiation by heating units in the test room onto the unit or onto the temperature measuring points shall be avoided.

4.2.1.3 Appliances with duct connection

The connections of a ducted air unit to the test facility shall be sufficiently air tight to ensure that the measured results are not significantly influenced by exchange of air with the surroundings.

4.2.1.4 Appliances with integral pumps

For appliances with integral and adjustable water or brine pumps, the pump speed shall be set at the same time as the temperature difference.

In case of a liquid pump with several fixed speeds or with variable speed, the manufacturer shall provide information on the settings of pump (speed or external static pressure to achieve).

4.2.1.5 Liquid chilling package for use with remote condenser

Units for use with remote condenser are tested by using a water-cooled condenser, the characteristics of which shall enable the intended operating conditions to be achieved.

4.2.2 Installation and connection of the test object

4.2.2.1 General

The test object shall be installed and connected for the test as recommended by the manufacturer in the installation and operation manual. The accessories provided by option are not included in the test. If a back-up heater is provided in option or not, it shall be switched off or disconnected to be excluded from the testing.

For single ducts, regardless of the manufacturer's instructions, the discharge duct shall be as short and straight as possible compatibly with minimum distance between the unit and the wall for correct air inlet but not less than 50 cm. No accessory shall be connected to the discharge end of the duct.

For double duct units, the same requirements apply to both suction and discharge ducts, unless the appliance is designed to be installed directly on the wall. For multisplit systems, the test shall be performed with the system operating at a capacity ratio of 1, or as close as possible.

When performing measures in heating mode, set the highest room temperature on the unit/system control device; when performing measures in cooling mode, set the lowest room temperature on the unit/system control device. If in the instructions, the manufacturer indicates a value for the temperature set on the control device for a given rating condition, then this value shall be used.

For unit with open-type compressor the electric motor shall be supplied or specified by the manufacturer. The compressor shall be operated at the rotational speed specified by the manufacturer.

For inverter type control units, the setting of the frequency shall be done for each rating condition. The manufacturer shall provide in the documentation information about how to obtain the necessary data to set the required frequencies.

If skilled personnel with knowledge of control software is required for the start of the system, the manufacturer or the nominated agent should be in attendance when the system is being installed and prepared for tests.

4.2.2.2 Installation of unit consisting of several parts

In the case of a unit consisting of several parts, the following installation conditions shall be complied for the test.

a) The refrigerant lines shall be installed in accordance with the manufacturer's instructions. The length of the lines shall be 5 m except if the constraints of the test installation make 5 m not possible, in which case a greater length may be used, with a maximum of 7,5 m.

b) The lines shall be installed so that the difference in elevation does not exceed 2,5 m.

c) The thermal insulation of the lines shall be applied in accordance with the manufacturer's instructions.

d) Unless constrained by the design, at least half of the connecting lines shall be exposed to the outside conditions, with the rest of the lines exposed to the inside conditions.

4.2.2.3 Indoor units of multisplit systems

When testing a multisplit system in a calorimeter room, the air flow rate and the external static pressure shall be adjusted separately for each one of the ducted indoor units.

When testing a multisplit system using the air enthalpy method, the air flow rate and the external static pressure shall be adjusted separately for each indoor unit, ducted or not.

In case of equipment with non-ducted indoor units tested using the air enthalpy method, the above requirement on ducted indoor units shall apply.

4.2.2.4 Measuring points

Temperature and pressure measuring points shall be arranged in order to obtain mean significant values.

For free air intake temperature measurements, it is required:

— either to have at least one sensor per square meter, with not less than four measuring points and by restricting to 20 the number of sensors equally distributed on the free air surface;

— or to use a sampling device. It shall be completed by four sensors for checking uniformity if the surface area is greater than 1 m^2.

Air temperature sensors shall be placed at a maximum distance of 0,25 m from the free air surface.

For control cabinet air conditioners, the inlet temperature at the evaporator is measured instead of the temperature inside the control cabinet.

For units consisting of a heat pump and a storage tank as a factory made unit, water inlet and outlet temperature measurements shall be taken at the inlet and outlet of this unit.

For water and brine, the density in Formulae (1), (2) and (3) shall be determined in the temperature conditions measured near the volume flow measuring device.

4.3 Uncertainties of measurement

The uncertainties of measurement shall not exceed the values specified in Table 1.

Table 1 — Uncertainties of measurement for indicated values

Measured quantity	Unit	Uncertainty of measurement
Liquid	°C	±0,15 K
- temperature difference	K	±0,15 K
- temperature inlet/outlet	K	±0,15 K
- volume flow	m^3/s	±1 %
- static pressure difference	kPa	±1 kPa ($\Delta p \leq 20$ kPa) or ± 5 %($\Delta p > 20$ kPa)
Air		
- dry bulb temperature	°C	±0,2 K
- wet bulb temperature	°C	±0,4K
- volume flow	m^3/s	±5 %
- static pressure difference	Pa	±5 Pa ($\Delta p \leq 100$ Pa) or ± 5 %($\Delta p > 100$ Pa)
Refrigerant		
- pressure at compressor outlet	kPa	±1 %
- temperature	°C	±0,5 K
Concentration (in mass)		
- Heat transfer medium	%	±2
Electrical quantities		
- electric power	W	±1 %
- voltage	V	±0,5 %
- current	A	±0,5 %
- electrical energy	kWh	±1 %
Compressor rotational speed	min^{-1}	±0,5 %

The heating or cooling capacities measured on the liquid side shall be determined within a maximum uncertainty of 5 % independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.

The steady-state heating or cooling capacities determined using the calorimeter method shall be determined with a maximum uncertainty of 5 %, independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids; this maximum uncertainty is extended to 10 % for single duct units due to the air exchange between the two compartments of the calorimeter room.

Heating capacity determined during transient operation (defrost cycles) using the calorimeter method shall be determined with a maximum uncertainty of 10 %, independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.

The heating and cooling capacities measured on the air side using the air enthalpy method shall be determined with a maximum uncertainty of 10 %, independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.

NOTE CEN ISO/TS 16491 provides guidelines for the calculation of the uncertainties of measurement of the capacity on the air side when using the calorimeter room or the air enthalpy methods.