SLOVENSKI STANDARD
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Klimatske naprave, enote za tekoļ insko hlajenje in toplotne ļ rpalke z elektriļ nimi kompresorji za segrevanje in hlajenje prostora - 3. del: Preskusne metode

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

Luftkonditionierer, Flüssigkeitskühlsätze und Wärmepumpen mit elektrisch angetriebenen Verdichtern für die Raumbehezung und Kühlung - Teil 3: Prüfverfahren

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

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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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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (prEN 14511-3:2009) 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 14511-3:2007.

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 2002/31/EC.

For relationship with EU Directive 2002/31/EC, see informative Annex ZA, which is an integral part of this document.

prEN 14511 comprises the following parts under the general title "*Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling*“:

— Part 1: Terms and definitions

— Part 2: Test conditions

— Part 3: Test methods

— Part 4: Requirements

1 Scope

1.1 The scope of prEN 14511-2:2009 is applicable.

1.2 This part of prEN 14511 specifies the test methods for the rating and performance of air and water-cooled air conditioners, liquid chilling packages, air-to-air, water-to-air, air-to-water and water-to-water heat pumps with electrically driven compressors when used for space heating and cooling.

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.

2 Normative references

The following referenced documents are indispensable for the application 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.

prEN 14511-1:2009, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 1: Terms and definitions*

prEN 14511-2:2009, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 2: Test conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 14511-1:2009 apply.

4 Rating capacity test

4.1 Basic principles

4.1.1 Heating capacity

The heating capacity of air conditioners and of air-to-air or water-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).

The heating capacity of air-to-water, water-to-water 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:

$$P_H = q \times \rho \times c_p \Delta t \qquad (1)$$

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.

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:

— if the fan or pump at the indoor heat exchanger is an integral part of the unit, the same power (calculated in 4.1.5.1 or 4.1.6.1) which is excluded from the total power input shall be also subtracted from the heating capacity;

— If the fan or pump at the indoor heat exchanger is not an integral part of the unit, the same power (calculated in 4.1.5.2 or 4.1.6.2) 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-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).

The cooling capacity of air-to-water, water-to-water 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:

$$P_C = q \times \rho \times c_p \Delta t \qquad (2)$$

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.

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 4.1.5.1 or 4.1.6.1) 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 4.1.5.2 or 4.1.6.2) 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 and water-to-water 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:

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

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.

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:

$$\frac{q \times \Delta p_e}{\eta} \text{ [W]} \quad (4)$$

where:

η is 0,3 by convention;

Δp_e is the measured available external static pressure difference, expressed in pascal, as defined in 2.56 of prEN 14511-1:2009;

q is the nominal air flow rate, expressed in cubic meters per second.

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:

$$\frac{q \times (-\Delta p_i)}{\eta} \text{ [W]} \quad (5)$$

where

η is 0,3 by convention;

Δp_i is the measured internal static pressure difference, expressed in pascal, as defined in 2.57 of prEN 14511-1:2009;

q is the nominal air flow rate, expressed in cubic meters per second.

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 liquid pumps, where applicable.

4.1.6.2 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:

$$\frac{q \times \Delta p_e}{\eta} \text{ [W]} \qquad (6)$$

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 2.56 of prEN 14511-1:2009;

q is the nominal water flow rate, expressed in cubic meters per second.

4.1.6.3 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:

$$\frac{q \times (-\Delta p_i)}{\eta} \text{ [W]} \qquad (7)$$

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 2.57 of prEN 14511-1:2009;

q is the nominal water flow rate, expressed in cubic meters per second.

4.1.6.3 In the case of appliances designed especially to operate on a distributing network of pressurised water without water-pump, no correction is to 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 external static pressure shall be set at the same time as the temperature difference.

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 his installation and operation manual. The accessories provided by option (for example heating element) are not included in the test.

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 his 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.

NOTE To set up a multisplit system which incorporates an inverter-controlled compressor, skilled personnel with a knowledge of control software may be required. The manufacturer or his 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 with 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, indoor units shall be either all non ducted or all ducted.

If they are ducted, all indoor units shall be of the same model, i.e. having the same airflow rate and the same external static pressure.

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 Measurements

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 and not less than four measuring points equally distributed on the 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 m².

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 the tank respectively.

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		
- temperature difference	K	± 0,15 K
- volume flow	m^3/s	± 1 %
- static pressure difference	Pa	± 5 %
Air		
- dry bulb temperature	°C	± 0,2 K
- wet bulb temperature	°C	± 0,3 K
- volume flow	m^3/s	± 5 %
- static pressure difference	Pa	± 5 Pa ($\Delta p \leq 100$ Pa)
Refrigerant		
- pressure at compressor outlet	kPa	± 1 %
- temperature	°C	± 0,5 K
Concentration		
- 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.

4.4 Test procedure

4.4.1 General

4.4.1.1 All units

The test conditions are given in prEN 14511-2:2009.

If liquid heat transfer media other than water are used, the specific heat capacity and density of such heat transfer media shall be determined and taken into consideration in the evaluation.

Table 4 states permissible deviations of the measured values from the test conditions.

4.4.1.2 Non ducted units

For non ducted units, the adjustable settings such as louvers and fan speed shall be set for maximum steady-state air flow.

For inverter type control units, if the manufacturer indicates a speed of the fan different from the maximum one to set on the control device for a given rating condition, then this speed shall be used.

4.4.1.3 Ducted indoor units

The volume flow and the pressure difference shall be related to standard air and with dry evaporator.

If the air flow rate is given by the manufacturer with no atmospheric pressure, temperature and humidity conditions, it shall be considered as given for standard air conditions.

The air flow rate given by the manufacturer shall be converted into standard air conditions. The air flow rate setting shall be made when the fan only is operating, at standard air conditions.

The rated airflow rate given by the manufacturer shall be set and the resulting external static pressure (ESP) measured.

If the ESP is lower than the minimum value given in Table 2 (or Table 3), the air flow rate is decreased to reach this minimum value.

If the ESP is greater than twice the minimum value given in Table 2 (or Table 3), the air low rate is increased to reach twice this minimum value.

If the ESP is greater than the minimum value given in Table 2 (or Table 3) but not greater than twice this minimum value, then keep this ESP.

The obtained settings of the air flow rate and ESP of the unit shall be maintained during all the tests.

4.4.1.4 Ducted outdoor units

The volume flow and the pressure difference shall be related to standard air and with dry heat exchanger.

If the air flow rate is given by the manufacturer with no atmospheric pressure, temperature and humidity conditions, it shall be considered as given for standard air conditions.

The air flow rate given by the manufacturer shall be converted into standard air conditions. The air flow rate setting shall be made when the fan only is operating, at standard air conditions.

The rated airflow rate given by the manufacturer shall be set and the resulting external static pressure (ESP) measured.