SLOVENSKI STANDARD
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SIST EN 12055:2001
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Klimatske naprave, enote za tekočinsko hlajenje in toplotne črpalke z električnimi 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 Raumheizung und -kühlung - Teil 3: Prüfverfahren

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

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

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This European Standard was approved by CEN on 30 April 2004.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 14511-3:2004) 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of an identical text or by endorsement, at the latest by November 2004, and conflicting national standards shall be withdrawn at the latest by November 2004.

This document supersedes EN 255-1:1997, EN 814-1:1997, EN 12055:1998.

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 Directive(s), see informative annex ZA, which is an integral part of this document.

This standard consists of the following parts:

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

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

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

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

Annexes A and B are normative and annexes C, D, E, F and G are informative.

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

1 Scope

This part of EN 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.

This European Standard applies to factory-made units that can be ducted.

This standard applies to factory-made liquid chilling packages with integral condensers or for use with remote condensers.

This standard applies to factory-made units of either fixed capacity or variable capacity by any means.

Packaged units, single split and multisplit systems are covered by this standard, except water-cooled multisplit systems.

In the case of units consisting of several parts, the standard applies only to those designed and supplied as a complete package, except for liquid chilling packages with remote condenser.

This standard is primarily intended for water and brine chilling packages but can be used for other liquid subject to agreement.

This standard applies to air-to-air air conditioners which evaporate the condensate on the condenser side.

The units having their condenser cooled by air and by the evaporation of external additional water are not covered by this standard.

This standard does not apply to units using transcritical cycles, e.g. with CO_2 as refrigerant.

Installations used for heating and/or cooling of industrial processes are not within the scope of this standard.

NOTE 1 Part load testing of units is dealt with in CEN/TS 14825.

NOTE 2 All the symbols given in this text should be used regardless of the language used.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 14511-1;2004, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Part 1: Terms and definitions.*

EN 14511-2:2004, *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 European Standard, the terms and definitions given in EN 14511-1:2004 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 or by the air enthalpy method which are described in annex A and annex B respectively.

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, in Watts;

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

ρ is the density, in kilograms per cubic metre;

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

Δt is the difference between inlet and outlet temperatures, 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 or by the air enthalpy method which are described in annex A and annex B respectively.

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:

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

where

P_C is the cooling capacity, in Watts;

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

ρ is the density, in kilograms per cubic metre;

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

Δt is the difference between inlet and outlet temperatures, 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, in Watts;

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

ρ is the density, in kilograms per cubic metre;

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

Δt is the difference between inlet and outlet temperatures 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 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:

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

where

η is 0,3 by convention;

Δp_e is the measured available external static pressure difference, in Pascals;

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

4.1.5.2 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:

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

where

η is 0,3 by convention;

Δp_i is the measured internal static pressure difference, in Pascals;

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

4.1.6 Power input of liquid pumps

4.1.6.1 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 0,3 by convention;

Δp_e is the measured available external static pressure difference, in Pascals;

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

4.1.6.2 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 0,3 by convention;

Δp_i is the measured internal static pressure difference, in Pascals;

q is the nominal water flow rate, 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

Ducted air systems 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 will 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 duct units, in case the manufacturer's instructions do not specify how to install the discharge duct, the following recommendations shall apply.

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 to the unit. The installation of the unit shall be such that any bend of the discharge duct is avoided.

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.

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, if the manufacturer gives instructions for the setting of the frequency for each rating condition, this setting shall be done.

NOTE To set up a multisplit system which incorporates an inverter-controlled compressor, skilled personnel with a 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.

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 instructions with a minimum length of 5 m and a greater length to a maximum of 7,5 m if the constraints of the test installation make 5 m not possible.

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.

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 inlet/outlet	°C	± 0,1 K
- volume flow	m^3/s	± 1 %
- static pressure difference	Pa	± 5 Pa (Δp ≤ 100 Pa) ± 5 % (Δp > 100 Pa)
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 (Δp ≤ 100 Pa) ± 5 % (Δp > 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.