SLOVENSKI STANDARD
SIST EN 15879-1:2011

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Preskušanje in ocenitev toplotnih črpalk zemlja/voda (neposredna izmenjava) z električnimi kompresorji za segrevanje in/ali hlajenje prostora - 1. del: Toplotne črpalke z neposredno izmenjavo z vodo

Testing and rating of direct exchange ground coupled heat pumps with electrically driven compressors for space heating and/or cooling - Part 1: Direct exchange-to-water heat pumps

Prüfung und Leistungsbemessung von Direktaustausch- Erdreichwärmepumpen mit elektrisch angetriebenen Verdichtern zur Raumbeheizung und/oder -kühlung - Teil 1: Direktaustausch/Wasser-Wärmepumpe

Essais et détermination des caractéristiques des pompes à chaleur à détente directe avec le sol avec compresseur entraîné par moteur électrique pour le chauffage et/ou la réfrigération des locaux - Partie 1: Pompes à chaleur à échange direct avec l'eau

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ICS:

27.080	Toplotne črpalke	Heat pumps

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English Version

Testing and rating of direct exchange ground coupled heat pumps with electrically driven compressors for space heating and/or cooling - Part 1: Direct exchange-to-water heat pumps

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Prüfung und Leistungsbemessung von erdreichgekoppelten Direktübertragung - Wärmepumpen mit elektrisch angetriebenen Verdichtern zur Raumbeheizung und/oder -kühlung - Teil 1: Direktübertragung/Wasser-Wärmepumpe

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Page

Foreword

This document (EN 15879-1:2011) 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of an identical text or by endorsement, at the latest by August 2011, and conflicting national standards shall be withdrawn at the latest by August 2011.

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1 Scope

This European Standard specifies the terms and definitions, test conditions, test procedures and requirements for the rating and performance of direct exchange-to-water ground coupled heat pumps with electrically driven compressors, used for space heating and/or cooling. Brine can be used instead of water.

This European Standard applies to factory-made units with horizontal in-ground collectors. In the case of units consisting of several parts, this standard applies only to those designed and supplied as a complete package.

Water-to-direct exchange and direct-exchange-to-direct exchange ground coupled heat pumps are covered by EN 15879-2.

Direct exchange-to-air ground coupled heat pumps and air-to-direct exchange heat pumps are covered by EN 15879-3.

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

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12102:2008, *Air conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling — Measurement of airborne noise — Determination of the sound power level*

EN 14511-1:2007, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling — Part 1: Terms and definitions*

EN 14511-3, *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling — Part 3: Test Methods*

EN 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 60335-2-40, *Household and similar electrical appliances — Safety — Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers (IEC 60335-2-40:2002, modified)*

EN 61000-3-11, *Electromagnetic compatibility (EMC) — Part 3-11: Limits; Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems; Equipment with rated current ≤ 75 A and subject to conditional connection (IEC 61000-3-11:2000)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14511-1:2007 and the following apply.

3.1
direct exchange ground coupled heat pump
heat pump which consists of an in-ground heat exchanger and a heat pump module

3.2
in-ground heat exchanger
heat exchanger buried in the ground that consists of a series of parallel loops, each consisting of a single tube, in which the refrigerant is circulating for a direct heat exchange with the ground

NOTE 1 The in-ground heat exchanger is connected to the heat pump module through vapour and liquid refrigerant lines.

NOTE 2 The in-ground heat exchanger is specified by the number and length of the parallel loops and the diameter of the single tubes.

3.3
heat pump module
assembly containing the refrigerating circuit components including the compressor, the expansion device, the indoor heat exchanger, all auxiliary components, control and safety devices and the refrigerant lines excluding the in-ground heat exchanger

3.4
brine-bath temperature
temperature of the brine which is maintained in the bath where the in-ground heat exchanger tubes are immersed, and which is calculated as the mean value of the brine at the inlet and outlet of the bath

4 Classification

The units are denominated in such a way that the heat transfer medium for the outdoor heat exchanger is given first, followed by the heat transfer medium for the indoor heat exchanger (see Table 1).

Table 1 — Designation of direct exchange-to-water (brine) heat pumps

Outdoor heat exchanger	Indoor heat exchanger	Designation	Classification
In-ground heat exchanger	Water	Direct exchange-to-water units	DX / water
	Brine	Direct exchange-to-brine units	DX / brine

5 Test conditions

5.1 Environmental conditions and electrical power supply requirements

The test shall be carried out under the environmental conditions around the heat pump module specified in Table 2.

For all units, electrical power, voltage and frequency shall be given by the manufacturer.

Table 2 — Environmental conditions

Type	Measured quantity	Environmental conditions
DX / water or DX / brine to be installed outdoors – heating operation	Air dry bulb temperature	0 °C to 7 °C
DX / water or DX / brine to be installed outdoors – cooling operation	Air dry bulb temperature	25 °C to 35 °C
DX / water or DX / brine to be installed indoors – heating or cooling operation	Air dry bulb temperature	15 °C to 30 °C

5.2 Rating conditions

For the rating tests, the appropriate test conditions shall be applied in accordance with:

Table 3 for the heating mode;

Table 4 for the cooling mode.

Table 3 — Rating conditions for the heating mode

		In-ground heat exchanger	Indoor heat exchanger	
		Bath temperature (°C)	Inlet temperature (°C)	Outlet temperature (°C)
Standard rating conditions	DX / water or DX / brine for low heating temperature applications	4	30	35
	DX / water or DX / brine for medium heating temperature applications	4	40	45
	DX / water or DX / brine for high heating temperature applications	4	47	55
	DX / water or DX / brine for very high heating temperature applications	4	55	65
Application rating conditions	DX / water or DX / brine for low heating temperature applications	4	25	30
	DX / water and DX / brine for low heating temperature applications	1,5	30	35
	DX / water and DX / brine for medium heating temperature applications	1,5	40	45

Table 4 — Rating conditions for the cooling mode

		In-ground heat exchanger	Indoor heat exchanger	
		Bath temperature (°C)	Inlet temperature (°C)	Outlet temperature (°C)
Standard rating conditions	DX / water or DX / brine for high cooling temperature applications	30	23-[a]	18
	DX / water or DX / brine for low cooling temperature applications	30	12-[a]	7
Application rating conditions	DX / water or DX / brine for high cooling temperature applications	10	[b]	18
	DX / water or DX / brine for low cooling temperature applications	10	[b]	7

(a) For reversed cycle units, the test is performed at the flow rate obtained during the test for the corresponding standard rating conditions in the heating mode in Table 3.

(b) With the water flow rate as determined for the standard rating condition.

6 Rating capacity tests

6.1 Basic principles

6.1.1 Heating capacity

The heating capacity of direct exchange heat pumps shall be determined in accordance with the direct method at the water or brine heat exchanger. This shall be done 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 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, in watts;

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

ρ is the density, in kilograms per cubic meter;

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

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

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

— if the pump at the indoor heat exchanger is an integral part of the unit, the same power (calculated in 6.1.3.1) which is excluded from the total power input shall also be subtracted from the heating capacity;

— if the pump at the indoor heat exchanger is not an integral part of the unit, the same power (calculated in 6.1.3.2) which is included in the effective total power input shall also be added to the heating capacity.

6.1.2 Cooling capacity

The cooling capacity of direct exchange heat pumps shall be determined in accordance with the direct method at the water or brine heat exchanger. This shall be done 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, in watts;

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

ρ is the density, in kilograms per cubic meter;

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

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

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

— if the pump at the indoor heat exchanger is an integral part of the unit, the same power (calculated in 6.1.3.1) which is excluded from the total power input shall also be added to the cooling capacity;

— if the pump at the indoor heat exchanger is not an integral part of the unit, the same power (calculated in 6.1.3.2) which is included in the effective total power input shall also be subtracted from the cooling capacity.

6.1.3 Power input of liquid pumps

If the liquid pump is integrated in 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 considered as an integral part of the unit.

6.1.3.1 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 from the following formula:

$$P_{LP} = \frac{q \times \Delta p_e}{\eta} \; [W] \quad (3)$$

where

η is the efficiency of the liquid pump according to EN 14511-3;

Δp_e is the measured external static pressure difference as defined in EN 14511-1, in pascal;

q is the nominal heat transfer medium flow rate, in cubic meters per second.

6.1.3.2 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: