EHPA Testing Regulation

Testing of Water/Water and Brine/Water Heat Pumps

Terms, Test Conditions and Test Method based on EN 14511-1 to 14511-4

Additional requirements for granting the international quality label for heat pumps

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Contents

1 Introduction

The test conditions and testing method for the EHPA Quality Label are based on the European standard EN 14511, Parts 1 to 4, version 2007. It applies for space heating, additionally requirements according EHPA Quality Label can be found in the text (they are also summarized in Annex A). Anything not defined in this test regulation should be handled in line with EN 14511.

A heat pump can be awarded the International Heat Pump Quality Label once it is successfully tested in accordance with this regulation. The process is described in the “EHPA regulations for granting the international quality label for electrically driven heat pumps”.

This regulation has been adopted by the EHPA Quality Label Committee. Any changes to them must be approved by the Committee.

2 Scope of testing regulation

The scope of this testing regulation is to specify the testing conditions and the test method for testing electrically driven water/water and brine/water heat pumps. In order to qualify for the EHPA Quality Label , the heat pump submitted for testing must be from series production.

2.1 Scope of testing

The scope of the test comprises:

a) A performance test for different standardized points as specified in EN 14511 Parts 2 & 3 and other points as defined in Chapter 5,
b) The testing of the operating range as defined by the manufacturer (see chapter 3.5 and 6.3),
c) A safety test (see chapter 6),
d) Sound measurement in accordance with EN 12102 (see chapter 7),
e) Testing the electrical characteristic values (see chapter 8).

2.2 Testing methods

2.2.1 Performance testing

Perform the test under constant ambient conditions, i.e., during the test, the set conditions (e.g. software and control devices) on both source and user sides must remain constant. This test determines the heat output and the electrical power consumed, from which the performance figure for the heat pump is calculated.

2.2.2 Testing the operating range

The operating range (max. 6 key points, see chapter 3.5 and figure 1 in Chapter 6) is declared by the manufacturer and describes the operating range for the heat pump which is covered by the full manufacturer’s warranty. Testing is performed to evaluate whether the heat pump can operate at the limits of the operating range for an extended period of time.

2.2.3 Uncertainties of measurement for indicated values

Measurement variables	Unit	Uncertainty of measurement (±) of the cited values
Water/brine		
- Temperature inlet/outlet	°C	0,1 K
- Volume flow	m^3/s	1 %
- Heat transfer medium (brine) concentration	%	2 %
- Static pressure difference	Pa	5 %
Electrical power	W	1 %
Voltage	V	0,5 %
Current	A	0,5 %
Electrical energy	kWh	1 %
The heat output determined by the water side must be determined such that there is a maximum 5% measurement uncertainty, regardless of the individual measurement inaccuracies.		

Table 1: Uncertainty of measurement (±) of the cited values in accordance with EN 14511-3 Section 4.3

2.2.4 Safety test

The safety of equipment is tested by simulating operational malfunctions during normal heat pump operation.

3 Terms and definitions

The following terms supplement the terms and definitions defined in EN 14511-1.

3.1 Heat source system

A heat source system is extracting the heat from the heat source (e.g. air, water, soil).

3.2 Heat sink system

A heat sink system is distributing the heat from the warm side (heat sink, condenser) of the heat pump to the heat distribution system (space heating, domestic hot water, swimming pools, etc.).

3.3 Heating capacity, P_H

Heat delivered by the heat pump to the heat transfer medium.

3.4 Effective power input, P_E

The average electrical power input of the unit within the defined interval of time obtained for operating the heat source system including all control, regulation and safety equipment.

3.5 Operating range

The working range for the heat pump as specified by the manufacturer, limited by a maximum of six points (see figure 1, in Chapter 6), and covered by full manufacturer warranty.

3.6 Safety range

The safety range are the conditions outside the operating range at which the safety devices prevent the heat pump from being damaged.

3.7 Acoustic power level

The acoustic power level is expressed in decibels, dB(A), as defined in EN 12012.

4 Test conditions

4.1 Ambient conditions and electrical data

Model:	Measurement variable:	Limit values:
Water-water resp. brine-water heat pumps	Ambient temperature	15 to 30 °C
	Electrical voltage (230V/400V; 50 Hz)	± 4% rated voltage

Table 2: Ambient conditions and electrical data[1] (see footnote below)

4.2 Test conditions for performance testing

Test conditions / testing points water/water heat pumps:

Test condit.	Standard	Type[1]	Tin (°C)	Tout (°C)	Tout (°C)	Tin (°C)
W10/W35[2]	**EN 14511-2**	**N/QL**	**10**	**7**	**35**	**30**
W10/W45	EN 14511-2	B	10	a	45	a
W15/W45	EN 14511-2	B	15	a	45	a
W10/W55	EN 14511-2	B	10	a	55	a
W15/W55	EHPA-DACH	B	15	a	55	a

[1] Type name: N -> standard rated point, B -> operating rated point, QL -> Quality Label

[2] For the EHPA-DACH Quality Label relevant test condition

a The test is conducted with the volume flows indicated for W10/W35, Quality Label point

Table 3a: Rated points for power testing of water/water heat pumps

Test conditions / testing points brine/water heat pumps:

Test condit.	Standard	Type[1]	Tin (°C)	Tout (°C)	Tout (°C)	Tin (°C)
B0/W35[2]	**EN 14511-2**	**N/QL**	**0**	**-3**	**35**	**30**
B5/W35	EN 14511-2	B	5	a	35	a
B0/W45	EN 14511-2	B	0	a	45	a
B5/W45	EN 14511-2	B	5	a	45	a
B-5/W45	EN 14511-2	B	-5	a	45	a
B0/W55	EN 14511-2	B	0	a	55	a
B5/W55	EHPA-DACH	B	5	a	55	a

[1] Type name: N -> standard rated point, B -> operating rated point, QL -> Quality Label

[2] For the EHPA-DACH Quality Label relevant test condition

a The test is conducted with the volume flows indicated for B0/W35, Quality Label point

Table 3b: Rated points for power testing of brine/water heat pumps

[1] Table 1, the testing conditions for the voltage are fixed according to common procedure in all EHPA test labs. This is not part of the standard.

4.3 Setting up and connecting the test object

The heat pump must be set up and connected for the test as recommended by the manufacturer in the installation and operating manual.

Heat pump start-up shall be performed by a manufacturer's representative otherwise the test laboratory shall charge the unit according to the specification of the manufacturer, which shall include:

- the quantity of refrigerant,
- the suction pressure and the superheating temperature
- and the expansion device or other component setting for achieving a correct operation of the heat pump.

Compact units automatically filled with refrigerant at the manufacturer's site can be delivered as produced. The manufacturer has to confirm that a control system documenting the filling is used.
If such a system does not exist the heat pump must be delivered filled with nitrogen and shall be charged with refrigerant defined be the manufacturer at the test laboratory.
The refrigerant type and charge must be in line with the technical data (marking plate) presented by the manufacturer.

4.4 Requirements for the test facility

4.4.1 Test conditions during heating operation – steady state

The following accuracy of parameter settings and measurements must be achieved during the tests:

Measurement variable:	Max. permissible deviation (±) of arithmetic mean from set value	Permissible dev. (±) of individual measured values from set values
Water/brine:		
Inlet temperature	0,2 K	0,5 K
Outlet temperature	0,3 K	0,6 K
Volume flow	2%	5%
Electrical voltage	4%	4%

Table 4: Permissible deviations (±) from set values.

5 Performance testing

5.1 General

If liquid heat transfer media other than water are used, the specific thermal capacity and density of the heat transfer medium must be determined and taken into account during the calculations.

When testing brine/water heat pumps, use a brine of 30 % by volume of ethylene glycol, with a freezing point of -15 °C.

Ensure, throughout the test, that no water drips or drains from any part of the equipment except from the drainage openings intended for the purpose.

5.2 Performance measurement procedure

5.2.1 Measurement of steady state or transient test conditions

Measure the outputs under steady-state conditions, which must be established prior to beginning the measurements. Steady-state conditions are regarded as met and maintained if all the measurement variables have been held constant for at least 60 minutes without having to change the set values. The following measurement period lasts for a minimum of 35 minutes.

Periodic fluctuations in the measured variables are permitted, according to the technical regulations, if the mean values of the permissible deviations as shown in Table 4 are not exceeded.

Record the measured values at least every 30 seconds throughout the entire test period.

5.3 Performance test with variable-output heat pumps

5.3.1 General

Standard heat pumps, which are run in on/off mode, always deliver full output during operation. Variable-output heat pumps, which can be run depending on need, can deliver reduced output during operation.

Make partial-load measurements with liquid flow rates as set at full load measurements during continuous operation.

The usage limit test, safety test and sound measurement are always performed with maximum heat output.

5.3.2 Heat pumps with variable capacity

All test points listed in Table 3 at 100 % heat output must be measured. For test point W10/W35 or B0/W35 an additional test is performed at the output level nearest to 50 % of the measured heat output. 50 % is based on the capacity measured at W10 or B0 and return temperature W30. The liquid flow rate is set at W10/W35 or B0/W35 full load and is maintained constant.

Other test points from Table 3 can be measured with the same output setting, if requested by the applicant. It must be possible to adjust the output levels during testing. The setting must remain constant during the test.

It must be possible manually to adjust the output levels during testing. The setting must not vary itself during the test.

5.4 Analysis

Calculations are in accordance with standard EN 14511 for information, equations used are listed in Annex B.

6 Safety test

The safety test checks if the safety devices respond correctly to operational malfunctions and protect the heat pump from damage. Perform this test in addition to the tests specified in EN 14511-4.

6.1 General

a) Perform this test at W10/W35 and B0/W35 under the conditions given in Chapter 4.2, Table 3a or 3b. When starting the test, the limit values as shown in Table 4 must be met.

b) To check the safety devices of the heat pump, simulate a series of operating states and malfunctions (see 6.2.a and 6.3.b, below). Before and after each simulated state or malfunction, the test object must reach the steady-state condition of normal operation for the indicated test condition.

c) For the safety tests, disable devices on the heat pump that do not serve as overload protection or safety devices. Any time delays that may be found must also be considered in the test periods in the test sequence. (This is done in coordination with the respective manufacturer.)

6.2 Malfunctions to be simulated

Maintain the simulated malfunctions for transfer medium flows for at least two hours[2]. The test object must not suffer any damage throughout the entire sequence of tests and must be fully functional after testing.

The heat pump must not switch on and off more than four times during the last 60 minutes of the test. If a safety device locks the heat pump out of operation (locking malfunction), the heat pump is considered to have passed the test and the test is ended.

a) Blocking the heat transfer medium flow/s (stop the circulation pump/s for the heat pump).

c) Complete power failure for at least five seconds. The heat pump must return to a stable operating state no later than 20 minutes after restarting the compressor.

The test is performed at the flow rate obtained during the test at W10/W35 or B0/W35.

6.3 Testing the usage limit

6.4 Purpose

The test at the boundaries is intended to show whether the heat pump is fully functional and operable in the warranted usage range stated by the manufacturer. For the test of usage limit (operating range) see Chapter 6.4 in standard EN14511-4.

6.4.1 Test conditions

The definition of the operating boundaries is explained in Section 2.2.2 and Figure 1 below. Use the values given by the manufacturer as target values for the source temperatures. Test have to be performed with same flow rates as used for the test point W10/W35 and B0/W35, and set the ambient conditions as shown in Table 2.

During the test conditions in Chapter 4 (Table 4) must not be exceeded.

6.4.2 Test sequence

The heat pump must remain in operation during the entire test period without being shut off by a safety device. There must be no damage to the heat pump throughout the entire test. The test object must remain in operation under the specified operating conditions for at least 60 minutes without external interference.

[2] This requirement is set by EHPA. In order to maintain the readibility of the text, it is made here and in the Annex A.

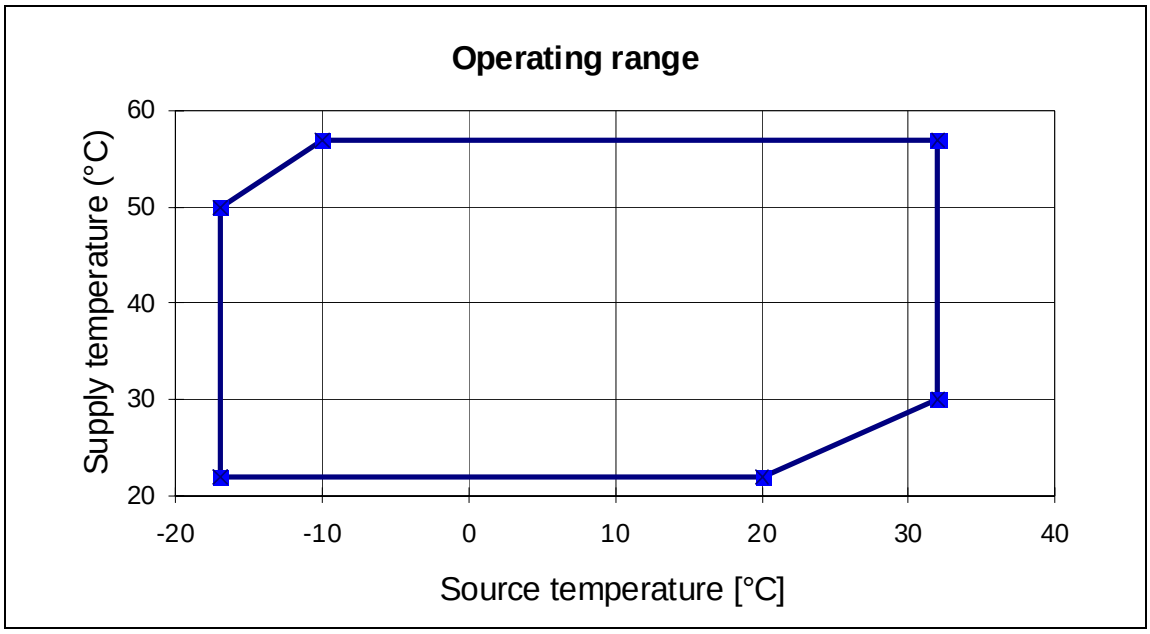

Figure 1: Example of the operating range defined by the manufacturer

7 Sound measurement

Test is performed according to EN 12102 and EN 14511-2 at test point B0/W35 or W10/W35 and with the same settings as for the other test points according to table 3a or 3b. For set up see standard EN 12102. For a combined test (water/water and brine/water heat test), measure the sound output only for the brine/water test. Measure the sound level by one of the following methods:

- Live room method in accordance with EN ISO 3741 and EN ISO 3743
- Free field method in accordance with EN ISO 3744 and EN ISO 3745
- Intensity method in accordance with EN ISO 9614-2
- EN ISO 3746
- EN ISO 3747, provided that the test environment meet the requirements for engineering method (grade 2)

8 Test of electrical characteristic values

The electrical characteristic values for the start and operation of each phase are recorded using a voltage analyzer. Only the measured state is given in the test report. This test is performed at the standard test point W10/W35 or B0/W35, as shown in Table 3. For a combined test (water/water and brine/water heat test), measure the electrical characteristic values only for the brine/water test.

9 Documentation provided by the manufacturer

9.1 Marking

Each heat pump unit must have a name plate securely and permanently attached. It must be applied such that it is easily readable and accessible and include the following information. For additional information see also EN 60335-1, -2-40:

- Manufacturer or supplier
- Model designation and serial number
- COP and heat output in kW with at least three significant figures for W10/W35 or B0/W35
- Type and filling weight of the refrigerant

10 Test reports

The heat pump test centers publish the test results only if the customer has approved such publication with an authorized signature. The full report is given according to the requirements in EN 14511-3 (Level 1 report). It belongs the consumer. A public summary report is published (Level 2), too.

10.1 Test report Level 1 (disclosure status: private):

This dossier contains all test documents and fulfills the requirements in EN 14511. Production of this test report is part of the overall test procedure, and the report is sent only to the manufacturer or the customer who has ordered the tests.

10.1.1 General Information on the testing institute

- Date:
- Name of the testing institute:
- Test location:
- Test method:
- Test supervisor:
- Test number:
- Type of refrigerant:
- Mass of refrigerant:

- Properties of fluids:
- References to this European Standard:
- References to the EHPA regulation and ver.:

10.1.2 Machine-specific information

- Name of the customer (usually the manufacturer)
- Machine type, designation
- Serial number (if not available, compressor serial number)
- Brief description of the design
- Rated volume flow/s on both sides at which the measurements were taken.
- Information on the components, such as compressor type, heat exchanger type, expansion valve type, etc.
- Year of production
- Photo of the machine
- Dimensions and weight of the heat pump

10.1.3 Operating range and safety test

- Extreme points tested and reached
- Safety test passed or failed

10.1.4 Electrical measurements

- Max. start current with or without soft starter
- Output factor (mean value).

10.1.5 Sound measurement

- As measured before.

10.2 Test report Level 2 (disclosure status: public)

This data serves mainly as the basis for EHPA Quality Label Database. It contains at least:

- Average heat output
- Average electrical power consumption
- COP for test points according test regulation
- Operating range and safety test
- Electrical measurements
- Sound measurements

Annex A – additional requirements according to EHPA

The test conditions and testing method for the EHPA Quality Label are based on the European standard EN 14511, Parts 1 to 4, version 2007. It applies for space heating, additionally requirements can be found in the text and are also summarized in this Annex. Anything not defined in this test regulation should be handled in line with EN 14511.

Chapter 4
Testing points are given in Chapter 4.2; Table 3a and 3b.

The ambient conditions and the electrical data for performance testing and functional inspection are listed in the Table below. The testing conditions for the voltage are fixed according to common procedure in all EHPA test labs.

Model:	**Measurement variable:**	**Limit values:**
Water-water resp. brine-water heat pumps	Ambient temperature	15 to 30 °C
	Electrical voltage (230V/400V; 50 Hz)	± 4% rated voltage
[1] Manufacturer's information		

Table 4: Ambient conditions and electrical data[3] (see footnote below)

For the heat pump start-up the following information shall be included, see 4.3:

- the quantity of refrigerant,

For refrigerant charge the value on the marking plate can be used (for compact, factory filled units with a monitoring system in place). In all other cases, the heat pump unit has to be delivered filled with nitrogen and shall be charged with refrigerant supplied by the test laboratory (see chapter 4.3).

Chapter 5
Flow rates must be indicated at for W10/W35 or B0/W35 for all test-points.

Chapter 6
All medium flow malfunctions are simulated for at least two hours, which is a longer time than prescribed in EN14511.

Regarding automatic restart after power-off simulation (see chapter 6.2), the test has not to be performed if the machine is not capable of restarting automatically after power supply failure.

Chapter 10
In the test report references to the EHPA regulation and version are required.

Annex B - Equations

Calculation of heat output/ heating capacity

Calculate the heat output of the test object as follows:

$$\dot{Q}_{HPaverage} = \frac{Q_{HP}}{t_{duration}} \quad [W] \quad (1)$$

where:

$$Q_{HP} = \sum_{i=1}^{n-1} \frac{\dot{Q}_{HP.average.i} + \dot{Q}_{HP.average.i+1}}{2} \quad [W] \quad (2)$$

where

$$Q_{HP} = q_W \cdot \rho_W(T_{return}) \cdot cp_w \cdot (T_{outlet} - T_{return}) \quad [W] \quad (3)$$

Definitions:

$\dot{Q}_{HP.average}$	Average heat output in [W]
Q_{HP}	Heat energy given off during the test in [J]
$\dot{Q}_{HP.j}$	Heat output for the i^{th} measurement in [W]
$\dot{Q}_{HP.}$	Present heat output in [W]
$t_{duration}$	Test duration in [s]
n	Number of measurement intervals
Δt	Duration of a measurement interval in [s]
q_w	Volume flow from the heat transfer medium on the warm side in [m³/s]
$\rho_{W/}(T_{return})$	Density of the heat transfer medium at return temperature in [kg/m³]
c_{pW}	Specific heat capacity of the heat transfer medium in [J/(kg K)]
$T_{outlet,}T_{return}$	Temperature of the heat transfer medium (outlet and return, respectively) in [K]

Calculation of power consumption

Calculate the effective power consumption of the heat pump from the power consumption of the compressor and all electrical equipment of the heat pump that functions during the heating mode.

Include the power consumption figures for the delivery apparatus of the heat pump only to such an extent as is required to overcome the internal static pressure differentials.

Calculate the power consumption of the heat pump as follows:

$$P_{HP.average} = \frac{E_{el}}{t_{duration}} \quad [W] \quad (4)$$

where:

$$E_{el} = \sum_{i=1}^{n-1} \frac{P_{HP.i} + P_{HP.i+1}}{2} \cdot \Delta t \quad [J] \quad (5)$$

where:

$$P_{HP} = P_{em} + P_{ep.w} + P_{ep.c} + P_E \quad [W] \quad (6)$$

where:

$$\pm P_{ep.w} = \frac{q_W \cdot \Delta p}{\eta_P} \quad [W] \quad (7)$$

where:

$$\pm P_{ep.c} = \frac{q_C \cdot \Delta p}{\eta_p} \quad [W] \quad (8)$$

Definitions:

$P_{HP.average}$	Average electrical power consumption in [W]
P_{HP}	Electrical power consumption of the entire heat pump in [W]
$P_{HP.i}$	Electrical power consumption for the i^{th} measurement in [W]
P_{em}	Electrical power consumption of the compressor in [W]
P_{ep}	Proportional electrical power consumption of the circulating pump in, warm or cold side, in [W]
P_E	Electrical power consumption of all additional mechanisms in [W]
E_{el}	Electrical energy consumed during the test in [J]
$t_{duration}$	Test duration in [s]
n	Number of measuring intervals
Δt	Duration of a measuring interval in [s]
q_W	Volume flow from the heat transfer medium on the cold or warm side in [m³/s]
q_C	Volume flow from the heat transfer medium on the cool side in [m³/s]
Δp	Static pressure drop (cold or warm side) in the heat exchanger via the heat pump in [Pa]
η_P	Efficiency of the circulating pump = 0.3 (cold or warm side) as given in EN 14511.

Determining the Coefficient of Performance (COP)

The COP (coefficient of performance) corresponds to the ratio of the heat output to the electrical power consumption as measured or calculated in the output test.

Calculate the average COP as follows:

$$COP_{HP} = \frac{Q_{HP}}{E_{el}} \quad [-] \qquad (9)$$

Definitions:

COP_{HP}	Coefficient of performance for the heat pump
Q_{HP}	Heat energy given off during the test in [J]
E_{el}	Electrical energy used during the test in [J]