

---

---

**Water-source heat pumps — Testing  
and rating for performance —**

Part 2:  
**Water-to-water and brine-to-water  
heat pumps**

*Pompes à chaleur à eau — Essais et détermination des  
caractéristiques de performance —*

*Partie 2: Pompes à chaleur eau-eau et eau glycolée-eau*

STANDARDSISO.COM : Click to view the full PDF of ISO 13256-2:2021



STANDARDSISO.COM : Click to view the full PDF of ISO 13256-2:2021



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vii</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols</b> .....	<b>4</b>
<b>5 Rating and test conditions</b> .....	<b>5</b>
5.1 Rating conditions for the determination of net capacities.....	5
5.1.1 Ratings.....	5
5.1.2 Load side liquid pump adjustment.....	5
5.1.3 Source side liquid pump adjustment.....	6
5.1.4 Liquid flow rates.....	7
5.1.5 Installation and connection of the unit.....	7
5.1.6 Test liquids.....	8
5.2 Rating test conditions for cooling and heating capacities.....	8
<b>6 Performance Requirements</b> .....	<b>9</b>
6.1 General.....	9
6.2 Maximum operating conditions test.....	10
6.2.1 Test conditions.....	10
6.2.2 Test procedures.....	10
6.2.3 Test requirements.....	10
6.3 Minimum operating conditions test.....	12
6.3.1 Test conditions.....	12
6.3.2 Test procedures.....	12
6.3.3 Test requirements.....	12
6.4 Enclosure sweat and condensate test.....	13
6.4.1 General.....	13
6.4.2 Test conditions.....	13
6.4.3 Test procedures.....	14
6.4.4 Test requirements.....	14
<b>7 Test methods</b> .....	<b>14</b>
7.1 General.....	14
7.2 General test requirements.....	14
7.3 Equipment installation.....	14
7.4 Cooling and heating capacity tests procedure.....	15
7.4.1 Reconditioning period.....	15
7.4.2 Data collection period.....	15
7.4.3 Net cooling capacity.....	15
7.4.4 Net heating capacity.....	16
7.5 Uncertainties of measurement.....	16
7.6 Data to be recorded.....	16
7.7 Uncertainties of measurements and permissible deviations for steady-state cooling and heating capacity tests.....	17
7.8 Test results.....	18
<b>8 Marking provisions</b> .....	<b>18</b>
8.1 Nameplate requirements.....	18
8.2 Nameplate information.....	18
8.3 Designation of standard rating capacities.....	19
8.4 Refrigerant Designation.....	19
<b>9 Publication of ratings</b> .....	<b>19</b>
9.1 Published ratings.....	19

9.2 Additional ratings.....	19
<b>Annex A (informative) Refrigerant enthalpy test method.....</b>	<b>20</b>
<b>Annex B (normative) Liquid enthalpy test method.....</b>	<b>22</b>
<b>Annex C (informative) Additional ratings based upon previous standard version ISO 13256-2:1998.....</b>	<b>24</b>
<b>Bibliography.....</b>	<b>26</b>

STANDARDSISO.COM : Click to view the full PDF of ISO 13256-2:2021

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 6, *Testing and rating of air-conditioners and heat pumps*.

This second edition cancels and replaces the first edition (ISO 13256-2:1998), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Significant updates to the formatting, symbols, and terms and definitions, have been included to more closely align with other pertinent ISO standards and the latest ISO requirements.
- The original water loop heat pump (WLHP), ground water heat pump (GWHP) and ground loop heat pump (GLHP) application rating designations, specifying entering liquid source rating test conditions, have been replaced with High, Medium, and Low source temperature range conditions to represent a wider operating map at both standard and partially loaded application rating conditions. It is now possible, when all three (High, Medium and Low) temperature ranges are specified by the manufacturer for energy modelling programs to interpolate performance at other entering water temperatures than those used in the standard.
- Specific antifreeze solution composition requirements have been removed to eliminate prescriptive language and promote industry innovation of novel and improved antifreeze solutions.
- The standard has been expanded to allow multiple heating capacity ratings at differing load temperature conditions (Very High, High, Medium, and Low). Medium was retained as the original load condition.
- Testing tolerances and uncertainties have been harmonized with other pertinent ISO standards.
- Annexes have been significantly updated and harmonized with other pertinent ISO standards.

A list of all parts in the ISO 13256 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

STANDARDSISO.COM : Click to view the full PDF of ISO 13256-2:2021

## Introduction

This document covers heating and cooling systems which are generally referred to as “water-source heat pumps.” These systems generally include an indoor heat exchanger with means to move the liquid, a compressor, and a refrigerant-to-water or refrigerant-to-brine heat exchanger. A system may provide both heating and cooling, cooling-only, or heating-only functions.

STANDARDSISO.COM : Click to view the full PDF of ISO 13256-2:2021

[STANDARDSISO.COM](https://standardsiso.com) : Click to view the full PDF of ISO 13256-2:2021

# Water-source heat pumps — Testing and rating for performance —

## Part 2: Water-to-water and brine-to-water heat pumps

### 1 Scope

**1.1** This document establishes performance testing and rating criteria for factory-made residential, commercial and industrial, electrically-driven, mechanical-compression type, water-to-water and brine-to-water heat pumps. The requirements for testing and rating contained in this document are based on the use of matched assemblies.

**1.2** Equipment may be designed for rating at one or several source and load side temperature conditions described in this document.

**1.3** This document does not apply to the testing and rating of individual assemblies for separate use, nor to the testing and rating of heat pumps covered in ISO 5151, ISO 13253 or ISO 13256-1.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 817, *Refrigerants — Designation and safety classification*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

#### 3.1

##### **water-to-water heat pump**

##### **brine-to-water heat pump**

heat pump which consists of one or more factory-made assemblies which normally include an indoor side refrigerant to water heat exchanger (load side), compressor(s), and outdoor-side refrigerant-to-water or refrigerant-to-brine heat exchanger(s) (source side), including means to provide both cooling and heating, cooling-only, or heating-only functions

Note 1 to entry: When such equipment is provided in more than one assembly, the separated assemblies should be designed to be used together.

Note 2 to entry: Such equipment may also provide functions of sanitary water heating.

**3.2**

**water-loop heat pump**

water-to-water heat pump using, on the source side, a liquid circulating in a common piping loop

Note 1 to entry: The temperature of the liquid loop is usually within a range of 10 °C to 30 °C.

**3.3**

**ground-water heat pump**

water-to-water heat pump using, on source side, water pumped from a well, lake, or stream

Note 1 to entry: The temperature of the water is related to the climatic conditions and is generally constant within the range from 5 °C to 25 °C for deep wells.

**3.4**

**ground-loop heat pump**

brine-to-water heat pump using, on the source side, a brine solution circulating through a subsurface piping loop

Note 1 to entry: The heat exchange loop may be placed in horizontal trenches or vertical bores, or be submerged in a body of surface water.

Note 2 to entry: The temperature of the brine is related to the heat exchange load and climatic conditions and is generally within a range from -5 °C to 40 °C.

**3.5**

**cooling capacity**

amount of heat that the equipment can remove from the water used to condition the indoor space in a defined interval of time

Note 1 to entry: Expressed in units of watts.

**3.6**

**net cooling capacity**

cooling capacity with load side liquid pump power adjustment

Note 1 to entry: Expressed in units of watts.

**3.7**

**heating capacity**

amount of heat that the equipment can add to the water used to condition the indoor space in a defined interval of time

Note 1 to entry: Expressed in units of watts.

**3.8**

**net heating capacity**

heating capacity with load side liquid pump power adjustment

Note 1 to entry: Expressed in units of watts.

**3.9**

**rated voltage**

voltage shown on the nameplate of the equipment

Note 1 to entry: Expressed in units of volts.

**3.10**

**rated frequency**

frequency shown on the nameplate of the equipment

Note 1 to entry: Expressed in units of Hz.

**3.11**  
**energy efficiency ratio**  
**EER**

ratio of the net cooling capacity to the effective power input at any given set of rating conditions

Note 1 to entry: Expressed in units of watt per watt.

**3.12**  
**coefficient of performance**  
**COP**

ratio of the net heating capacity to the effective power input of the equipment at any given set of rating conditions

Note 1 to entry: Expressed in units of watt per watt.

**3.13**  
**effective power input**

average electrical power input to the equipment within a defined interval of time; i.e., the sum of:

- the power input for operation of the compressor excluding additional electrical heating devices,
- the power input of all control and safety devices of the equipment, and
- the proportional power input of the conveying devices for the transport of the heat transfer media through the heat pump only (e.g., source and load sides liquid pumps, whether internal or external, whether provided with the equipment or not)

Note 1 to entry: Expressed in units of watts.

**3.14**  
**brine**

heat transfer liquid that has a freezing point lower than the freezing point of water

**3.15**  
**external static pressure difference**  
 $\Delta p_e$

pressure difference measured between the water (or brine) outlet section and the water (or brine) inlet section of the unit, which is available for overcoming the pressure drop of any additional water (or brine) circuit

Note 1 to entry: Expressed in units of pascals.

**3.16**  
**internal static pressure difference**  
 $\Delta p_i$

pressure difference measured between the water (or brine) outlet section and the water (or brine) inlet section of the unit, which corresponds to the total pressure drop of all components on the water (or brine) side of the unit

Note 1 to entry: Expressed in units of pascals.

**3.17**  
**fixed capacity heat pump**

equipment which does not have possibility to change its capacity

Note 1 to entry: This definition applies to each cooling and heating operation individually.

**3.18**  
**two-stage capacity heat pump**

equipment where the capacity is varied by two steps

Note 1 to entry: This definition applies to each cooling and heating operation individually.

**3.19 multi-stage capacity heat pump**

equipment where the capacity is varied by three or four steps

Note 1 to entry: This definition applies to each cooling and heating operation individually.

**3.20 variable capacity heat pump**

equipment where the capacity is varied by five or more steps to represent continuously variable capacity

Note 1 to entry: This definition applies to each cooling and heating operation individually.

**3.21 source side**

source side is referring to outdoor side heat exchanger and the liquid, water or brine, circulating in it

**3.22 load side**

load side is referring to indoor side heat exchanger and the liquid, water, circulating in it

**3.23 standard rating conditions**

operating conditions while establishing the standard rating net cooling and/or heating capacities

Note 1 to entry: These conditions correspond to an operation of the heat pump at full capacity, in relation to the source side.

**3.24 application rating conditions**

operating conditions while establishing additional cooling and/or heating capacities

Note 1 to entry: These conditions correspond to an operation of the heat pump at reduced capacity, in relation to the source side.

**3.25 standard rating capacity**

net cooling and/or heating capacity measured at standard rating conditions

**4 Symbols**

Symbol	Description and Units
$c_{pf}$	specific heat of liquid, J/kgK
$\Delta_{pi}$	measured internal static pressure difference, Pa
$\Delta_{pe}$	measured external static pressure difference, Pa
$h_{r1}$	specific enthalpy of refrigerant entering indoor side, J/kg
$h_{r2}$	specific enthalpy of refrigerant leaving indoor side, J/kg
$\eta$	representative efficiency
$P_i$	power input to indoor-side compartment, W
$\phi_c$	total power input
$\phi_{nc}$	net cooling capacity, W
$\phi_{nh}$	net heating capacity, W
$\phi_{pai}$	load side pump power adjustment for non integrated pump, W
$\phi_{pae}$	load side pump power adjustment for integrated pump, W
$\phi_{paoi}$	source side pump power adjustment for non integrated pump, W

$\phi_{paoe}$	source side pump power adjustment for integrated pump, W
$\phi_{ci}$	cooling capacity, (load-side data), W
$\phi_{co}$	cooling capacity, (source-side data), W
$\phi_{hi}$	heating capacity, (load-side data), W
$\phi_{ho}$	heating capacity, (source side data), W
$q$	measured volumetric flow rate, l/s
$q_{ro}$	refrigerant and oil mixture flow rate, m <sup>3</sup> /s
$t_{f3}$	temperature, liquid entering equipment, °C
$t_{f4}$	temperature, liquid leaving equipment, °C
$W_1$	mass of cylinder and bleeder assembly, empty, g
$W_3$	mass of cylinder and bleeder assembly, with sample, g
$W_5$	mass of cylinder and bleeder assembly, with oil from sample, g
$w_f$	liquid mass flow rate, kg/s
$X_0$	concentration of oil to refrigerant-oil mixture
$X_r$	mass ratio, refrigerant to refrigerant-oil mixture

## 5 Rating and test conditions

### 5.1 Rating conditions for the determination of net capacities

#### 5.1.1 Ratings

Rating shall be established at the test conditions specified in 5.2, using the test procedures described in Clause 7. Ratings relating to cooling and heating capacities shall be net values (see 7.4.3 and 7.4.4), including the effects of liquid pump heat (see 7.4.3 and 7.4.4), but not including supplementary heat. Energy efficiency ratios shall be based on the effective power input as defined in 3.10.

#### 5.1.2 Load side liquid pump adjustment

##### 5.1.2.1 Heat pump with non-integrated load side liquid pump

If no load side liquid pump is provided with the heat pump, a pump power adjustment is to be included in the effective power input to the heat pump, using the following formula:

$$\phi_{pai} = \frac{q \times (\Delta_{pi})}{\eta} \quad (1)$$

where

$\phi_{pai}$  is the pump power adjustment, in W;

$\eta$  = 0,3 by convention;

$\Delta_{pi}$  is the absolute value of the measured indoor-side internal static pressure difference, in Pa;

$q$  is the measured volumetric fluid flow rate, in cubic meter per second.

##### 5.1.2.2 Heat pump with integrated load side liquid pump

If a load side liquid pump is an integral part of a heat pump, only the portion of the pump power required to overcome the internal resistance shall be included in the effective power input to the heat pump. The

fraction which is to be excluded from the total power consumed by the pump shall be calculated using [Formula \(1\)](#):

$$\phi_{pae} = \frac{q \times \Delta_{pe}}{\eta} \quad (2)$$

where

$\phi_{pae}$  is the pump power adjustment, in W;

$\eta$  = 0,3 by convention;

$\Delta_{pe}$  is the measured indoor-side external static pressure difference, in Pa;

$q$  is the measured volumetric fluid flow rate, in m<sup>3</sup>/s.

### 5.1.3 Source side liquid pump adjustment

#### 5.1.3.1 Heat pump with non-integrated source side liquid pump

If no source side liquid pump is provided with the heat pump, a pump power adjustment is to be included in the effective power consumed by the heat pump, using [Formula \(3\)](#):

$$\phi_{paoi} = \frac{q \times (\Delta_{pi})}{\eta} \quad (3)$$

where

$\phi_{paoi}$  is the pump power adjustment, in W;

$\eta$  = 0,3 by convention;

$\Delta_{pi}$  is the absolute value of the measured internal static pressure difference, in Pa;

$q$  is the measured volumetric fluid flow rate, in m<sup>3</sup>/s.

#### 5.1.3.2 Heat pump with integrated source side liquid pump

If a source side liquid pump is an integral part of the heat pump, only the portion of the pump power required to overcome the internal resistance shall be included in the effective power input to the heat pump. The fraction which is to be excluded from the total power consumed by the pump shall be calculated using [Formula \(4\)](#):

$$\phi_{paoe} = \frac{q \times \Delta_{pe}}{\eta} \quad (4)$$

where

$\phi_{paoe}$  is the pump power adjustment, in W;

$\eta$  = 0,3 by convention;

$\Delta_{pe}$  is the measured external static pressure difference, in Pa;

$q$  is the measured volumetric fluid flow rate, in m<sup>3</sup>/s.

## 5.1.4 Liquid flow rates

### 5.1.4.1 General

All ratings shall be determined at liquid flow rates described below, expressed as cubic meter per second.

### 5.1.4.2 Source side flowrate

The manufacturer shall specify a flow rate, for the source side for all of the tests performed unless automatic adjustment of the liquid flow rate is provided by the equipment. A separate control signal output for each step of liquid flow rate will be considered as an automatic adjustment.

### 5.1.4.3 Load side flowrate

#### 5.1.4.3.1 Ratings where the leaving temperature on the load side is fixed

For units with integral liquid pump, the external static pressure shall be set at the same time as the temperature difference. When the liquid pump has one or several fixed speeds, the speed of the pump shall be set in order to provide the minimum external static pressure. In case of variable speed liquid pump, the manufacturer shall provide information to set the pump in order to reach a maximal external static pressure of 10 kPa.

#### 5.1.4.3.2 Rating where the leaving temperature on the load side is not fixed

The flowrate shall be set as specified by the manufacturer.

## 5.1.5 Installation and connection of the unit

### 5.1.5.1 General

The unit shall be installed and connected for the test as recommended by the manufacturer in the installation manual. In particular, pipe insulation shall follow the manufacturer requirements. The accessories provided as option are not included in the test.

### 5.1.5.2 Requirements for separated assemblies

In the case of heat pumps consisting of separate matched assemblies, the following installation procedures shall be followed.

- a) Each refrigerant line shall be installed in accordance with the manufacturer's instructions with the maximum stated length or 7,5 m, whichever is shorter. If the interconnecting tubing is furnished as an integral part of the equipment and not recommended for cutting the length, the equipment shall be tested with the complete length of tubing furnished.
- b) The lines shall be installed without any significant difference in elevation (not more than 2,5 m).
- c) Thermal insulation shall be applied to the lines in accordance with the manufacturer's instructions;
- d) Unless constrained by the design, at least half of the interconnecting lines shall be exposed to the outdoor conditions with the rest of the lines exposed to the indoor conditions.

### 5.1.5.3 Measuring points

The temperature and pressure sensors shall be positioned as close as possible to the unit inlets and outlets, on both source and load side and shall be arranged in order to obtain mean significant values.

For the measurement of the external static pressure on both heat source and load side, the pressure sensors shall be placed as close as possible to the unit inlets and outlets (on source and load side), on a straight section. Any bend in between the inlets and outlets and the sensor shall be avoided.

**5.1.6 Test liquids**

The test liquid for all tests except low source side temperature tests shall be water or brine of a composition and concentration specified by the manufacturer.

The test liquid for low source side temperature tests (H1) shall be brine of a composition and concentration specified by the manufacturer.

The test liquid shall be sufficiently free of gas to ensure that the measured result is not influenced by the presence of gas.

**5.2 Rating test conditions for cooling and heating capacities**

**5.2.1** The test conditions for the determination of cooling capacities are specified in [Table 1](#). The test conditions for determination of heating capacities are specified in [Table 2](#).

Heat pumps shall be rated at least at standard rating conditions and at one or several cooling and/or heating conditions for source and load sides as defined by [Table 1](#) and [2](#). The selected standard rating conditions should be reflected on the product (see [8.3](#)).

NOTE Previous rating conditions can be found in [Annex C](#), [Tables C.1](#), [C.2](#) and [C.3](#).

**5.2.2** Fixed capacity heat pumps shall be rated at standard rating conditions for one or several cooling and/or heating conditions for source and load sides as defined by [Tables 1](#) and [2](#).

**5.2.3** Two stage and multi stage capacity heat pumps shall be rated at maximum capacity at standard rating conditions and at minimum capacity at application rating conditions for one or several cooling and/or heating conditions for source and load sides as defined by [Tables 1](#) and [2](#). Additional ratings may be applied at application rating conditions.

**5.2.4** Variable capacity heat pumps shall be rated at the maximum continuous capacity allowed by the controls at standard rating conditions and at the minimum capacity allowed by the controls at application rating conditions for one or several cooling and/or heating conditions for source and load sides as defined by [Tables 1](#) and [2](#). Additional ratings may be applied at application rating conditions.

**Table 1 — Rating test conditions for the determination of cooling capacity**

	<b>C3</b> high source tem- perature	<b>C2</b> medium source tem- perature	<b>C1</b> low source tem- perature
Load side entering temperature °C	12/ <sup>c</sup>	12/ <sup>c</sup>	12/ <sup>c</sup>
Air surrounding unit installed indoors - dry bulb, °C	15 to 30	15 to 30	15 to 30
Air surrounding unit installed outdoors - dry bulb, °C	35	35	35
<u>Standard rating conditions</u>	30/ <sup>c</sup>	20/ <sup>c</sup>	10/ <sup>c</sup>
Source side entering temperature, °C			
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate			

Table 1 (continued)

	<b>C3</b> high source temperature	<b>C2</b> medium source temperature	<b>C1</b> low source temperature
Application rating conditions Source side entering temperature, °C	25/ <sup>c</sup>	15/ <sup>c</sup>	5/ <sup>c</sup>
Frequency <sup>a</sup>	Rated	Rated	Rated
Voltage <sup>b</sup>	Rated	Rated	Rated
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate			

Table 2 — Rating test conditions for the determination of heating capacity

	<b>H3</b> high source temperature	<b>H2</b> medium source temperature	<b>H1</b> Low source temperature
Load side temperature, °C	55/65	55/65	55/65
v-Very High Entering/Leaving	47/55	47/55	47/55
h-High Entering/Leaving	40/ <sup>b</sup>	40/ <sup>b</sup>	40/ <sup>b</sup>
m-Medium <sup>a</sup> Entering/Leaving	30/35	30/35	30/35
l-Low Entering/Leaving			
Air surrounding unit installed indoor - dry bulb, °C	15 to 30 7	15 to 30 7	15 to 30 7
Air surrounding unit installed outdoor - dry bulb, °C			
<b>Standard rating conditions</b>			
Source side entering temperature, °C	20/ <sup>b</sup>	10/ <sup>b</sup>	0/ <sup>b</sup>
Application rating conditions Source side entering temperature, °C	25/ <sup>b</sup>	15/ <sup>b</sup>	5/ <sup>b</sup>
Frequency <sup>c</sup>	Rated	Rated	Rated
Voltage <sup>d</sup>	Rated	Rated	Rated
<sup>b</sup> Leaving temperature at manufacturer specified flowrate. <sup>c</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>d</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published.			

## 6 Performance Requirements

### 6.1 General

To comply with this document, water (brine)-to-water heat pumps shall meet the applicable requirements of this document.

For heat pumps with capacity control, the performance requirements tests shall be conducted at the maximum capacity as determined in standard rating conditions.

**6.2 Maximum operating conditions test**

**6.2.1 Test conditions**

For maximum operating conditions tests, a single heating and/or cooling when applicable shall be conducted at the test conditions established for the specific source side and load side temperature conditions (see 5.2) specified in Tables 3 and 4.

**6.2.2 Test procedures**

The equipment shall be operated continuously for one hour after the specified conditions have been established at each specified voltage level.

The 110 % voltage test shall be conducted prior to the 90 % voltage test.

All power to the equipment shall be cut off for 3 min at the conclusion of the one hour test at the 90 % voltage level and then restored for one hour.

**6.2.3 Test requirements**

Heat pumps shall meet the following requirements when operating at the conditions specified in Tables 3 and 4.

During the entire test, the equipment shall operate without any indication of damage.

During the test period specified in 6.2.2, the motor overload protective device may trip only during the first 5 min of operation after the shutdown period of 3 min. During the remainder of the test period, no motor overload protective device shall trip. For those models so designed that resumption of operation does not occur within the first 5 min after the initial trip, the equipment may remain out of operation for no longer than 30 min. It shall then operate continuously for the remainder of the test period.

**Table 3 — Maximum cooling test conditions**

<b>Rated Temperature Range:</b>	<b>C3 high source temperature</b>	<b>C2 medium source temperature</b>	<b>C1 low source temperature</b>
Load side entering temperature, °C	30 <sup>c</sup>	30 <sup>c</sup>	30 <sup>c</sup>
Air surrounding unit installed indoor - dry bulb, °C	15 to 30	15 to 30	15 to 30
Air surrounding unit installed outdoor - dry bulb, °C	35	35	35
Source side entering temperature, °C	40 <sup>c</sup>	40 <sup>c</sup>	40 <sup>c</sup>
Frequency <sup>a</sup>	Rated	Rated	Rated
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate			

Table 3 (continued)

Rated Temperature Range:	C3 high source temperature	C2 medium source temperature	C1 low source temperature
Voltage <sup>b</sup>	1) 90 % and 110 % of rated voltage for equipment with a single nameplate rating,  2) 90 % of minimum voltage and 110 % of maximum voltage for equipment with dual nameplate voltage.	1) 90 % and 110 % of rated voltage for equipment with a single nameplate rating,  2) 90 % of minimum voltage and 110 % of maximum voltage for equipment with dual nameplate voltage.	1) 90 % and 110 % of rated voltage for equipment with a single nameplate rating,  2) 90 % of minimum voltage and 110 % of maximum voltage for equipment with dual nameplate voltage.
<p><sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency.</p> <p><sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published.</p> <p><sup>c</sup> Leaving temperature at manufacturer specified flowrate</p>			

Table 4 — Maximum heating test conditions

Rating Temperature Range:	H3 high source temperature	H2 medium source temperature	H1 low source temperature
Load side entering temperature, °C	50/ <sup>c</sup>	50/ <sup>c</sup>	50/ <sup>c</sup>
Air surrounding unit installed indoor - dry bulb, °C	15 to 30 7	15 to 30 7	15 to 30 7
Air surrounding unit installed outdoor - dry bulb, °C			
Source side entering temperature, °C	30/ <sup>c</sup>	30/ <sup>c</sup>	30/ <sup>c</sup>
Frequency <sup>a</sup>	Rated	Rated	Rated
<p><sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency.</p> <p><sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published.</p> <p><sup>c</sup> Leaving temperature at manufacturer specified flowrate</p>			

**Table 4 (continued)**

Rating Temperature Range:	H3 high source temperature	H2 medium source temperature	H1 low source temperature
Voltage <sup>b</sup>	1) 90 % and 110 % of rated voltage for equipment with a single nameplate rating,  2) 90 % of minimum voltage and 110 % of maximum voltage for equipment with dual nameplate voltage.	1) 90 % and 110 % of rated voltage for equipment with a single nameplate rating,  2) 90 % of minimum voltage and 110 % of maximum voltage for equipment with dual nameplate voltage.	1) 90 % and 110 % of rated voltage for equipment with a single nameplate rating,  2) 90 % of minimum voltage and 110 % of maximum voltage for equipment with dual nameplate voltage.
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate			

**6.3 Minimum operating conditions test**

**6.3.1 Test conditions**

For minimum operating conditions test, a single heating and/or cooling test when applicable shall be tested at the test conditions established for the specific applications (see 5.2) specified in Tables 5 and 6. Heat pumps intended for use in two or more source and/or load side temperature conditions shall be tested at the most stringent set of conditions specified in Tables 5 and 6.

**6.3.2 Test procedures**

For the minimum operating cooling test, the heat pump shall be operated continuously for a period of no less than 30 min after the specified temperature conditions have been established. For the minimum operating heating test, the heat pump shall soak for 10 min with liquid at the specified temperature circulating through the coil. The equipment shall then be started and operated continuously for 30 min.

**6.3.3 Test requirements**

No protective device shall trip during these tests and no damage shall occur to the equipment.

**Table 5 — Minimum cooling test conditions**

Rating Temperature Range:	C3 high source temperature	C2 medium source temperature	C1 low source temperature
Load side entering temperature, °C	12/ <sup>c</sup>	12/ <sup>c</sup>	12/ <sup>c</sup>
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate.			

Table 5 (continued)

Rating Temperature Range:	C3 high source temperature	C2 medium source temperature	C1 low source temperature
Air surrounding unit installed indoor - dry bulb, °C	15 to 30	15 to 30	15 to 30
Air surrounding unit installed outdoor - dry bulb, °C	35	35	35
Source side entering temperature, °C	10/ <sup>c</sup>	10/ <sup>c</sup>	10/ <sup>c</sup>
Frequency <sup>a</sup>	Rated	Rated	Rated
Voltage <sup>b</sup>	Rated	Rated	Rated
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate.			

Table 6 — Minimum heating test conditions

Rating Temperature Range:	H3 high source temperature	H2 medium source temperature	H1 low source temperature
Load side entering temperature, °C	15/ <sup>c</sup>	15/ <sup>c</sup>	15/ <sup>c</sup>
Air surrounding unit installed indoor - dry bulb, °C	15 to 30	15 to 30	15 to 30
Air surrounding unit installed outdoor - dry bulb, °C	7	7	7
Source side entering temperature, °C	5/ <sup>c</sup>	5/ <sup>c</sup>	-5/ <sup>c</sup>
Frequency <sup>a</sup>	Rated	Rated	Rated
Voltage <sup>b</sup>	Rated	Rated	Rated
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate.			

## 6.4 Enclosure sweat and condensate test

### 6.4.1 General

Only applicable to heat pump designed to operate in cooling mode.

### 6.4.2 Test conditions

The enclosure sweat and condensate test shall be conducted in the cooling mode at the test conditions established for the specific applications specified in [Table 7](#). All controls shall be set to produce the maximum tendency to sweat, provided such settings are not contrary to the manufacturer's instructions to the user. Heat pumps intended for two or more source and/or load sides temperature conditions shall be tested at the most stringent set of conditions.

Table 7 — Enclosure sweat and condensate test conditions

	C3 high source temperature	C2 medium source temperature	C1 low source temperature
Load side entering temperature, °C	12/ <sup>c</sup>	12/ <sup>c</sup>	12/ <sup>c</sup>
Air surrounding unit installed indoor - dry bulb, °C	27	27	27
Air surrounding unit installed outdoor - dry bulb, °C	35	35	35
Source side entering temperature, °C	10/ <sup>c</sup>	10/ <sup>c</sup>	10/ <sup>c</sup>
Frequency <sup>a</sup>	Rated	Rated	Rated
Voltage <sup>b</sup>	Rated	Rated	Rated
<sup>a</sup> Equipment with dual-rated frequencies shall be tested at each frequency. <sup>b</sup> Equipment with dual-rated voltages shall be tested at both voltages or at the lower of the two voltages if only a single rating is published. <sup>c</sup> Leaving temperature at manufacturer specified flowrate			

### 6.4.3 Test procedures

After establishment of the specified source and load sides temperature conditions, the heat pump shall be operated continuously for a period of four hours.

### 6.4.4 Test requirements

No condensed water shall drip or run off the equipment's casing during the test.

## 7 Test methods

### 7.1 General

The capacity ratings shall be determined by the test methods and procedures established in this [Clause 7](#). The cooling and heating capacities shall be the results obtained simultaneously using the liquid enthalpy test method ([Annex B](#)) on both the source side and the load side.

The cooling or heating capacity measured on the source side shall agree within 5 % with the cooling or heating capacity determined from the measurements on the load side in order for the test to be valid.

Alternatively, for novel configurations where the liquid enthalpy test method cannot be employed on the load side, the cooling and heating capacity may be measured using the refrigerant enthalpy test method as described in [Annex A](#).

The resulting net cooling and net heating capacities are the cooling and heating capacities measured on the load side and corrected from the liquid pump power adjustment, as specified in [7.4.3](#) and [7.4.4](#).

### 7.2 General test requirements

The indoor and/or outdoor condition test room shall be a room or space in which the desired test conditions can be maintained within the permissible deviations.

### 7.3 Equipment installation

The equipment to be tested shall be installed in accordance with the manufacturer's installation instructions using recommended installation procedures, required external pumps and any other accessories. No alterations to the equipment shall be made except for the attachment of required test

apparatus and instruments in the prescribed manner. Where necessary, equipment shall be evacuated and charged with the type and amount of refrigerant specified in the manufacturer's instructions. Pumps not connected to the unit but provided with the unit are to be installed and considered integral.

## 7.4 Cooling and heating capacity tests procedure

### 7.4.1 Reconditioning period

The test room reconditioning apparatus and the equipment under test shall be operated until equilibrium conditions are attained. Equilibrium conditions is considered obtained and maintained when all the measured quantities remain constant without having to alter the set values, for a minimum duration of 30 min, with respect to the permissible deviations given in [Table 11](#). Periodic fluctuations of measured quantities caused by the operation of regulation and control devices are permissible, on condition the mean value of such fluctuations does not exceed the permissible deviations listed in [Table 11](#).

### 7.4.2 Data collection period

For the data collection period, it is necessary to record all the meaningful data continuously. In the case of recording instruments which operate on a cyclic basis, the sequence shall be adjusted such that a complete recording is affected at least once every 30 s. The output shall be measured in the steady-state condition. The steady-state condition is considered obtained and maintained when all the measured quantities remain constant without having to alter the set values with respect to the permissible deviations given in [Table 11](#). The duration of measurement shall be not less 30 min.

### 7.4.3 Net cooling capacity

#### 7.4.3.1 Heat pump with non-integrated load side liquid pump

Net cooling capacity is calculated as in [Formula \(5\)](#):

$$\phi_{nc} = \phi_{ci} - \phi_{pai} \quad (5)$$

where

$\phi_{ci}$  is the cooling capacity on the load side, in W;

$\phi_{pai}$  is the load side pump power adjustment for non-integrated pump, in W.

#### 7.4.3.2 Heat pump with integrated load side liquid pump

Net cooling capacity is calculated as in [Formula \(6\)](#):

$$\phi_{nc} = \phi_{ci} + \phi_{pae} \quad (6)$$

where

$\phi_{ci}$  is the cooling capacity on the load side, in W;

$\phi_{pae}$  is the load side pump power adjustment for integrated pump, in W.

#### 7.4.4 Net heating capacity

7.4.4.1 Heat pump with non-integrated load side liquid pump net heating capacity is calculated as in [Formula \(7\)](#):

$$\phi_{nh} = \phi_{hi} + \phi_{pai} \quad (7)$$

where

$\phi_{hi}$  is the heating capacity on the load side, in W;

$\phi_{pai}$  is the load side pump power adjustment for non-integrated pump, in W.

7.4.4.2 Heat pump with integrated load side liquid pump

Net heating capacity is calculated as in [Formula \(8\)](#):

$$\phi_{nh} = \phi_{hi} - \phi_{pae} \quad (8)$$

where

$\phi_{hi}$  is the heating capacity on the load side, in W;

$\phi_{pae}$  is the load side pump power adjustment for integrated pump, in W.

#### 7.5 Uncertainties of measurement

The uncertainties of measurement shall not exceed the values specified in [Table 10](#). For standard rating condition, the rating capacities shall be determined within a maximum uncertainty of 5 % from each of source and load sides, independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.

#### 7.6 Data to be recorded

The data to be recorded during the test include the following.

**Table 8 — Data to be recorded**

No.	Data	Unit
1	Date	
2	Observer(s)	
3	Barometric pressure	kPa
4	Equipment nameplate data	
5	Time data was recorded	
6	Effective power input to equipment	W
7	Applied voltage(s)	V
8	Frequency	Hz
9	Load side external static pressure difference, liquid (for units with integral pumps)	Pa
10	Load side internal static pressure difference, liquid (for units without integral pumps)	Pa
11	Liquid temperature entering indoor (load) heat exchanger	°C
12	Liquid temperature leaving indoor (load) heat exchanger	°C
13	Liquid flow rate indoor (load) heat exchanger	m <sup>3</sup> .s <sup>-1</sup>
14	Liquid temperature entering outdoor (source) heat exchanger	°C

Table 8 (continued)

No.	Data	Unit
15	Liquid temperature leaving outdoor (source) heat exchanger	°C
16	Liquid flow rate outdoor (source) heat exchanger	m <sup>3</sup> .s <sup>-1</sup>
17	Source side external static pressure difference, liquid (for units with integral pumps)	Pa
18	Source side internal static pressure difference, liquid (for units without integral pumps)	Pa
19	Temperature of air surrounding the unit	°C

### 7.7 Uncertainties of measurements and permissible deviations for steady-state cooling and heating capacity tests

The uncertainties of measurement are listed in [Table 9](#). The allowable variation during the capacity test reading is listed in [Table 10](#).

Table 9 — Uncertainties of measurement for indicated values

Measured quantity	Uncertainty of measurement <sup>a</sup>
Water:	0,15 K
— temperature	0,15 K
— temperature difference	1 %
— volume flow	1 kPa for pressure ≤20 kPa
— static pressure difference	5 % for pressure >20 kPa
Electrical measurements	0,5 %
Time	0,2 %
Mass	1,0 %
Speed	1,0 %

NOTE Uncertainty of measurement comprises, in general, many components. Some of these components may be estimated on the basis of the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. Estimates of other components can be based on experience or other information. ISO/TC 16491 is available as an appropriate guidance.

<sup>a</sup> Uncertainty of measurement is an estimate characterizing the range of values within which the true value of the measurement lies, based on a 95 % confidence interval (see ISO/IEC Guide 98-3).

Table 10 — Permissible deviations in capacity test readings

Reading	Variations of arithmetical mean values from specified test conditions	Maximum variation of individual readings from specified test conditions
Liquid temperature entering	± 0,2 K	± 0,5 K
Liquid temperature leaving	± 0,2 K	± 0,5 K <sup>a</sup>
Temperature of air surrounding unit:	± 0,3 K	± 0,5 K
— dry-bulb		
Voltage	± 1 %	± 2 %
Liquid volume flow rate	± 1 %	± 2 %

<sup>a</sup> The permissible deviations represents the greatest permissible difference between the maximum and minimum observations during the test.

The allowable variation of any observation during the performance tests is listed in [Table 11](#).

**Table 11 — Permissible deviations in performance test readings**

Quantity measured	Maximum variation of individual readings from stated performance test conditions
For minimum operating conditions test:	
— air temperatures	+ 1 K
— liquid temperatures	+ 0,6 K
For maximum operating conditions test:	
— air temperatures	- 1 K
— liquid temperatures	- 0, K
For other tests:	
— air temperatures	± 1 K
— liquid temperatures	± 0,6 K

## 7.8 Test results

For given test conditions, the capacity test results shall include the following as applicable:

**Table 12 — Capacity test result data**

Number	Data	Unit
1	cooling capacity	W
2	heating capacity	W
3	measured power input to equipment	W
4	liquid indoor (load) pump power adjustment	W
5	liquid outdoor (source) pump power adjustment	W
6	effective power input to equipment or power inputs to all equipment	W
7	net cooling capacity	W
8	net heating capacity	W
9	energy efficiency ratio	W/W
10	coefficient of performance	W/W

## 8 Marking provisions

### 8.1 Nameplate requirements

Each water-to-water and brine-to-water heat pump, whether composed of a single package or separate assemblies, shall have a durable nameplate, firmly attached to each separate assembly in a location accessible for reading.

### 8.2 Nameplate information

The nameplate shall provide the following minimum information in addition to the information required in international safety standards.

- a) Manufacturer's name or trademark<sup>1)</sup>.
- b) Distinctive type or model designation and serial number.

1) The manufacturer is considered to be the firm identified on the nameplate.

- c) Standard rating capacity (see 7.4). Equipment rated for more than one source and/or load side temperature conditions shall state standard rating capacities for both heating and cooling, as appropriate, for each temperature conditions.
- d) Rated voltage(s).
- e) Rated frequency(ies).
- f) Refrigerant designation and refrigerant mass charge (see 8.4).

### 8.3 Designation of standard rating capacities

The designation of standard rating capacities shall be established in such a way that the source and load sides media are indicated (IW = load side water, W = source side water, and B = source side brine), together with their temperatures, followed by their capacities in kilowatts. The standard capacities rating shall be stated to the nearest kilowatt (1 kW = W/1000). The first figure shall be the high liquid source temperature of the heat pump; the second figure shall be the medium liquid source temperature of the heat pump; the last figure shall be the low liquid source temperature of the heat pump all at the medium load side temperature condition.

EXAMPLE:

Cooling: IW12 - W30/W20/B10 10/11/12 kW

Heating: IW40 - W20/W10/B0 10/9/8 kW

### 8.4 Refrigerant Designation

The refrigerant designation shall be in accordance with ISO 817.

## 9 Publication of ratings

### 9.1 Published ratings

Ratings at standard and application rating conditions shall be published for the net heating capacity, the net cooling capacity, energy efficiency ratio, and coefficient of performance, as appropriate, for each heat pump rated in accordance with this document for each intended source and load side temperature conditions. These ratings shall be based on data obtained in accordance with the testing procedures specified in this document.

The values of the rating capacities shall be expressed in kilowatts (1 kW = W/1000), rounded to three significant figures.

The values of energy efficiency ratios and coefficients of performance shall be rounded to the nearest 0,05.

Each capacity rating shall be followed by the corresponding voltage and frequency ratings

Standard rating capacities are representative of equipment operating at zero external static pressure for both air and liquid flows. To derive performance of specific applications see [Annex C](#).

### 9.2 Additional ratings

Additional ratings may be published based on conditions other than those specified as standard and application rating conditions if they are clearly specified and the data are determined by the methods specified in this document, or by analytical methods which are verifiable by the test methods prescribed in [Clause 7](#), and are accompanied by the standard and application net capacity ratings, energy efficiency ratios, and the coefficients of performance.

## Annex A (informative)

### Refrigerant enthalpy test method

#### A.1 General

**A.1.1** In the refrigerant enthalpy test method, capacity is determined from the refrigerant enthalpy change and flow-rate. Enthalpy changes are determined from measurements of entering and leaving pressures and temperatures of the refrigerant, and the flow-rate is determined by a suitable flow meter in the liquid line.

**A.1.2** This method may be used for tests of equipment in which the refrigerant charge is not critical and where normal installation procedures involve the field connection of refrigerant lines.

**A.1.3** This method should neither be used for tests in which the refrigerant liquid leaving the flow meter is sub-cooled to less than 2,0 °C nor for tests in which the superheat of the vapour leaving the indoor-side is less than 3,0 °C.

**A.1.4** Cooling and heating capacities obtained by the refrigerant enthalpy method should include the thermal effects of the fan.

#### A.2 Refrigerant flow method

**A.2.1** The refrigerant flow-rate should be measured with an integrating-type flow meter connected in the liquid line upstream of the refrigerant control device. This meter should be sized such that its pressure drop does not exceed the vapour pressure change that a 2,0 K temperature change would produce.

**A.2.2** Temperature and pressure measuring instruments and a sight glass should be installed immediately downstream of the meter to determine if the refrigerant liquid is adequately sub-cooled. Sub-cooling of 2,0 K and the absence of any vapour bubbles in the liquid leaving the meter are considered adequate. It is recommended that the meter be installed at the bottom of a vertical downward loop in the liquid line to take advantage of the static head of the liquid thus provided.

**A.2.3** At the completion of testing, a sample of the circulating refrigerant and oil mixture may be taken from the equipment and its concentration of oil,  $X_o$ , calculated using [Formula \(A.1\)](#):

$$X_o = \frac{W_5 - W_1}{W_3 - W_1} \quad (\text{A.1})$$

where

$W_1$  is the mass of cylinder and bleeder assembly, empty, g;

$W_3$  is the mass of cylinder and bleeder assembly, with sample, g;

$W_5$  is the mass of cylinder and bleeder assembly, with oil from sample, g;

The total indicated flow rate should be corrected for the amount of oil circulating.