STANDARD

ANSI/AHRI/ASHRAE ISO Standard 13256-1:1998 (RA 2012)
Reaffirmation of ANSI/ARI/ASHRAE ISO Standard 13256-1:1998

Water-source heat pumps – Testing and rating for performance – Part 1: Water-to-air and brine-to-air heat pumps

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NOTE

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

This part of ISO 13256 was developed by ISO Technical Committee TC 86, Refrigeration, Subcommittee SC 6, Testing and rating of air-conditioners and heat pumps.

ISO 13256 consists of the following parts, under the general title Water-source heat pumps—Testing and rating for performance:

- *Part 1: Water-to-air and brine-to-air heat pumps*
- *Part 2: Water-to-water and brine-to-water heat pumps*

Annexes A, B, C, D, and E form an integral part of this part of ISO 13256. Annexes F, G, and H are for information only.

INTRODUCTION

This part of ISO 13256 covers heating and cooling systems which are generally referred to as "water-source heat pumps." These systems generally include an indoor coil with air-moving means, 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.

1. SCOPE

1.1 This part of ISO 13256 establishes performance testing and rating criteria for factory-made residential, commercial and industrial, electrically-driven, mechanical-compression type, water-to-air and brine-to-air heat pumps. The requirements for testing and rating contained in this part of ISO 13256 are based on the use of matched assemblies.

1.2 Equipment designed for rating at one application under this part of ISO 13256 may not be suitable at all applications covered in this part of ISO 13256.

1.3 This part of ISO 13256 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 13256-2.

Note: For the purpose of the remaining clauses, the terms "equipment" or "heat pumps" may be used to mean "water-to-air heat pumps" or "brine-to-air heat pumps" and the term "liquid" refers to either "water" or "brine."

2. NORMATIVE REFERENCE

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 13256. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 13256 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 817:2005, *Refrigerants—Designation system.*

3. DEFINITIONS

For the purposes of this part of ISO 13256, the following definitions apply.

3.1 water-to-air heat pump and/or brine-to-air heat pump

heat pump which consists of one or more factory-made assemblies which normally include an indoor conditioning coil with air-moving means, compressor(s), and refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to provide both cooling and heating, cooling-only, or heating-only functions

Notes:

1. When such equipment is provided in more than one assembly, the separated assemblies should be designed to be used together.
2. Such equipment may also provide functions of sanitary water heating, air cleaning, dehumidifying, and humidifying.

3.1.1 water-loop heat pump application

water-to-air heat pump using liquid circulating in a common piping loop functioning as a heat source/heat sink

Note: The temperature of the liquid loop is usually mechanically controlled within a temperature range of 15°C to 40°C.

3.1.2 ground-water heat pump application

water-to-air heat pump using water pumped from a well, lake, or stream functioning as a heat source/heat sink

Note: The temperature of the water is related to the climatic conditions and may vary from 5°C to 25°C for deep wells.

3.1.3 ground-loop heat pump application

brine-to-air heat pump using a brine solution circulating through a subsurface piping loop functioning as a heat source/heat sink

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Notes:

1. The heat exchange loop may be placed in horizontal trenches or vertical bores, or be submerged in a body of surface water.
2. The temperature of the brine is related to the climatic conditions and may vary from –5°C to 40°C.

3.2 total cooling capacity

amount of sensible and latent heat that the equipment can remove from the conditioned space in a defined interval of time, in watts, as determined by the specified test methods

3.3 net total cooling capacity

total cooling capacity with fan power adjustment (See 4.1.3)

3.4 heating capacity

amount of heat that the equipment can add to the conditioned space in a defined interval of time, in watts, as determined by the specified test methods

3.5 net heating capacity

heating capacity with fan power adjustment (See 4.1.3)

3.6 rated voltage

voltage shown on the nameplate of the equipment, in volts

3.7 rated frequency

frequency shown on the nameplate of the equipment, in hertz

3.8 energy efficiency ratio (EER)

ratio of the net total cooling capacity to the effective power input at any given set of rating conditions, in watts per watt

3.9 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, in watts per watt

3.10 standard air

dry air at 20.0°C and 101.324 kPa having a mass density of 1.204 kg/m^3

3.11 effective power input

average electrical power input to the equipment within a defined interval of time, in watts; 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., fans, pumps, whether internal or external, whether provided with the equipment or not)

(See 4.1.3 and 4.1.4.)

3.12 latent cooling capacity

amount of latent heat that the equipment can remove from the conditioned space in a defined interval of time, in watts

3.13 sensible cooling capacity

amount of sensible heat that the equipment can remove from the conditioned space in a defined interval of time, in watts

4. RATING AND TEST CONDITIONS

4.1 Rating conditions for the determination of capacity

4.1.1 Standard ratings

Standard ratings shall be established at the standard rating conditions specified in 4.2, using the test procedures described in clause 6. Standard ratings relating to cooling and heating capacities shall be net values, including the effects of circulating-fan heat, but not including supplementary heat. Standard efficiency ratings shall be based on the effective power input as defined in 3.11.

4.1.2 Power input of fans for heat pumps without duct connection

In the case of heat pumps which are not designed for duct connection and which are equipped with an integral fan, all power consumed by the fans shall be included in the effective power input to the heat pump.

4.1.3 Power input of fans for heat pumps with duct connection

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

$$\phi_{fa} = \frac{q \times \Delta p}{\eta}$$

where

ϕ_{fa} is the fan power adjustment, in watts;
η = 0.3×10^3 by convention;
Δp is the measured internal static pressure difference, in pascals;
q is the nominal airflow rate, in litres per second.

This value shall be added to the heating capacity and subtracted from the cooling capacity.

4.1.3.2 If a fan is an integral part of a heat pump, only the portion of the fan 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 fan shall be calculated using the following formula:

$$\phi_{fa} = \frac{q \times \Delta p}{\eta}$$

where

ϕ_{fa} is the fan power adjustment, in watts;
η = 0.3×10^3 by convention;
Δp is the measured external static pressure difference, in pascals;
q is the nominal airflow rate, in litres per second.

This value shall be subtracted from the heating capacity and added to the cooling capacity.

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4.1.4 Power input of liquid pumps

4.1.4.1 If no 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 the following formula:

$$\phi_{pa} = \frac{q \times \Delta p}{\eta}$$

where

ϕ_{pa} is the pump power adjustment, in watts;

η = 0.3×10^3 by convention;

Δp is the measured internal static pressure difference, in pascals;

q is the nominal fluid flow rate, in litres per second.

4.1.4.2 If a 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 the following formula:

$$\phi_{pa} = \frac{q \times \Delta p}{\eta}$$

where

ϕ_{pa} is the pump power adjustment, in watts;

η = 0.3×10^3 by convention;

Δp is the measured external static pressure difference, in pascals;

q is the nominal fluid flow rate, in litres per second.

4.1.5 Airflow rates

4.1.5.1 All standard ratings shall be determined at airflow rates as described below. All airflow rates shall be expressed as litres per second of standard air as defined in 3.10.

4.1.5.2 Ducted heat pumps which have integral fans shall be tested at the airflow rates specified by the manufacturer, or those obtained at zero external static pressure difference, whichever provides the lower airflow rate.

4.1.5.3 Ducted heat pumps which do not have integral fans, but which are tested in combination with a device employing a fan, shall be tested as described in 4.1.5.2. Ducted heat pumps which do not have integral fans but which are rated for general use with a variety of air moving devices, shall be tested at the airflow rates specified by the manufacturer in the published ratings. However, the pressure drop across the indoor coil assembly and the recommended enclosures and attachment means shall not exceed 75 Pa.

4.1.5.4 Non-ducted heat pumps shall be tested at the airflow rates obtained at zero external static pressure difference.

4.1.5.5 The manufacturer shall specify a single airflow rate for all tests required in this part of ISO 13256 unless automatic adjustment of airflow rate is provided by the equipment. A separate control signal output for each step of airflow rate shall be considered as an automatic adjustment.

4.1.6 Liquid flow rates

4.1.6.1 All standard ratings shall be determined at a liquid flow rate described below, expressed as litres per second.

4.1.6.2 Heat pumps with integral liquid pumps shall be tested at the liquid flow rates specified by the manufacturer or those obtained at zero external static pressure difference, whichever provides the lower liquid flow rate.

4.1.6.3 Heat pumps without integral liquid pumps shall be tested at the flow rates specified by the manufacturer.

4.1.6.4 The manufacturer shall specify a single liquid flow rate for all of the tests required in this part of ISO 13256 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.

4.1.7 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 m).

4.1.8 Requirements for heat pumps with capacity control

4.1.8.1 Part-load conditions shall be used for rating tests at levels or steps less than that of maximum capacity.

4.1.8.2 Heat pumps with fixed steps of capacity control shall be rated at each step of capacity. Heat pumps with variable capacity control shall be rated at no less than two capacity levels, the minimum and the maximum capacities.

4.1.9 Test liquids

4.1.9.1 The test liquid for water-loop heat pumps and ground-water heat pumps shall be water.

4.1.9.2 The test liquid for ground-loop heat pumps shall be a 15% solution by mass of sodium chloride in water.

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

4.2 Standard rating and part-load rating test conditions

4.2.1 The test conditions for the determination of standard and part-load cooling ratings are specified in Table 1.

4.2.2 The test conditions for determination of standard and part-load heating ratings are specified in Table 2.

4.2.3 Heat pumps intended for a specific application shall be rated at the conditions specified for that application, for example, water-loop, ground-water, or ground-loop applications.

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TABLE 1 Test conditions for the determination of cooling capacity

	Water-loop heat pumps	Ground-water heat pumps	Ground-loop heat pumps
Air entering indoor side			
— dry bulb, °C	27	27	27
— wet bulb, °C	19	19	19
Air surrounding unit			
— dry bulb °C	27	27	27
Standard rating test			
Liquid entering heat exchanger, °C	30	15	25
Part-load rating test			
Liquid entering heat exchanger,°C	30	15	20
Frequency*	Rated	Rated	Rated
Voltage**	Rated	Rated	Rated

* Equipment with dual-rated frequencies shall be tested at each frequency.
** 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.

TABLE 2 Test conditions for the determination of heating capacity

	Water-loop heat pumps	Ground-water heat pumps	Ground-loop heat pumps
Air entering indoor side			
— dry bulb, °C	20	20	20
— wet bulb, °C	15	15	15
Air surrounding unit			
— dry bulb, °C	20	20	20
Standard rating test			
Liquid entering heat exchanger, °C	20	10	0
Part-load rating test			
Liquid entering heat exchanger, °C	20	10	5
Frequency*	Rated	Rated	Rated
Voltage**	Rated	Rated	Rated

* Equipment with dual-rated frequencies shall be tested at each frequency.
** 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.

be identified as such (i.e., water-loop heat pump, ground-water heat pump, or ground-loop heat pump). Heat pumps intended for two or three applications shall be rated at the conditions specified for each of these applications and shall be so identified (see 7.3).

4.2.4 For each test, the equipment shall be operated continuously until equilibrium conditions are attained, but for not less than one hour before capacity test data are recorded. The data shall then be recorded for 30 min at 5-min intervals until seven consecutive sets of readings have been attained within the tolerances specified in 6.4. The averages of these data shall be used for the calculation of the test results.

5. PERFORMANCE REQUIREMENTS

5.1 General

5.1.1 To comply with this part of ISO 13256, water-to-air and brine-to-air heat pumps shall be designed and produced such that any production unit will meet the applicable requirements of this part of ISO 13256.

5.1.2 For heat pumps with capacity control, the performance requirements tests shall be conducted at maximum capacity.

5.2 Maximum operating conditions test

5.2.1 Test conditions

The maximum operating conditions tests shall be conducted for cooling and heating at the test conditions established for the specific applications (see 4.2.3) specified in Tables 3 and 4. Heat pumps intended for use in two or more applications shall be tested at the most stringent set of conditions specified in Tables 3 and 4.

5.2.2 Test procedures

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

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

5.2.2.3 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.

5.2.3 Test requirements

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

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

5.2.3.2 During the test period specified in 5.2.2.1, the equipment shall operate continuously without tripping any motor overload or other protective devices.

5.2.3.3 During the test period specified in 5.2.2.3, 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.

5.3 Minimum operating conditions test

5.3.1 Test conditions

Heat pumps shall be tested at the minimum operating test conditions for cooling and heating at the test conditions

TABLE 3 Maximum cooling test conditions

	Water-loop heat pumps	Ground-water heat pumps	Ground-loop heat pumps
Air entering indoor side*			
— dry bulb, °C	32	32	32
— wet bulb, °C	23	23	23
Air surrounding unit			
— dry bulb, °C	32	32	32
Liquid entering heat exchanger*, °C	40	25	40
Frequency**	Rated	Rated	Rated
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.	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.

* Air and liquid flow rates shall be as established in 4.1.5 and 4.1.6.
** Equipment with dual-rated frequencies shall be tested at each frequency.

TABLE 4 Maximum heating test conditions

	Water-loop heat pumps	Ground-water heat pumps	Ground-loop heat pumps
Air entering indoor side*			
— dry bulb, °C	27	27	27
Air surrounding unit			
— dry bulb, °C	27	27	27
Liquid entering heat exchanger*, °C	30	25	25
Frequency**	Rated	Rated	Rated
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.	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.

* Air and liquid flow rates shall be as established in 4.1.5 and 4.1.6.
** Equipment with dual-rated frequencies shall be tested at each frequency.

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