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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

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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.

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).

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).

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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.

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.

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.

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
Δpe
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
Δpi
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
Δ_{pi}	Measured internal static pressure difference, Pa
Δ_{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
η	representative efficiency
P_i	power input to indoor-side compartment, W
ϕ_c	Total power input
ϕ_{nc}	Net cooling capacity, W
ϕ_{nh}	Net heating capacity, W
ϕ_{pai}	Load side pump power adjustment for non integrated pump, W
ϕ_{pae}	Load side pump power adjustment for integrated pump, W
ϕ_{paoi}	Source side pump power adjustment for non integrated pump, W