

---

---

**Air to water heat pumps — Testing  
and rating at part load conditions and  
calculation of seasonal coefficient of  
performance for space heating**

*Chauffe-eau à pompe à chaleur — Essais et détermination des  
caractéristiques à charge partielle et calcul de performance  
saisonnière*



This document is a preview generated by EUS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2023

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

Foreword.....	v
Introduction.....	vi
<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>8</b>
<b>5 Installation requirements.....</b>	<b>9</b>
5.1 Test apparatus and uncertainties of measurement.....	9
5.2 Test room for the airside.....	10
5.3 Installation and connection of the heat pump.....	10
5.4 Installation of heat pumps consisting of several parts.....	11
5.5 Environment conditions for indoor unit installation and electrical power supply requirements.....	11
<b>6 Setting and part load test conditions.....</b>	<b>11</b>
6.1 General.....	11
6.2 Setting for capacity ratio.....	11
6.3 Setting the external static pressure difference for ducted units.....	11
6.4 Setting of units with integral pumps.....	12
6.5 Part load test conditions.....	12
<b>7 Space heating test.....</b>	<b>15</b>
7.1 Heating capacity test.....	15
7.2 Heating capacity correction.....	16
7.2.1 General.....	16
7.2.2 Capacity correction due to indoor liquid pump.....	16
7.2.3 Effective power input.....	17
7.3 Test procedure.....	19
7.3.1 General.....	19
7.3.2 Permissible deviations.....	19
7.3.3 Preconditioning period.....	20
7.3.4 Equilibrium period.....	21
7.3.5 Data collection period.....	21
7.4 Heating capacity calculation.....	21
7.4.1 Steady state capacity test.....	21
7.4.2 Transient capacity test.....	21
7.5 Effective power input calculation.....	21
7.5.1 Steady state test.....	21
7.5.2 Transient capacity test.....	21
7.6 Determination of degradation coefficient $C_d$ .....	21
7.7 Test methods for electric power input during thermostat-off mode, standby mode, crankcase heater mode and off mode.....	22
7.7.1 Uncertainties of measurement.....	22
7.7.2 Measurement of electric power input during thermostat-off mode.....	22
7.7.3 Measurement of electric power input during standby mode.....	23
7.7.4 Measurement of electric power input during crankcase heater mode.....	23
7.7.5 Measurement of electric power input during off mode.....	23
<b>8 Calculation methods for seasonal coefficient of performance (<math>S_{COP}</math>).....</b>	<b>23</b>
8.1 General formula for calculation of $S_{COP}$ .....	23
8.2 Calculation of the reference annual heating demand, $Q_H$ .....	24
8.3 Calculation of the annual energy consumption, $Q_{HE}$ .....	24
8.4 Calculation of $S_{COP, on}$ and $S_{COP, net}$ .....	24
8.5 Calculation procedure for determination of $C_{pb}$ values at part load conditions A to G.....	26

8.5.1	General	26
8.5.2	Calculation procedure for fixed capacity units	26
8.5.3	Calculation procedure for staged and variable capacity units	26
<b>9</b>	<b>Test results and test report</b>	<b>27</b>
9.1	Data	27
9.2	Test report	28
<b>10</b>	<b>Marking provisions</b>	<b>29</b>
10.1	General	29
10.2	Nameplate requirements	29
10.3	Nameplate information	29
<b>Annex A</b> (normative)	<b>Heating capacity test procedures given in <a href="#">7.3</a></b>	<b>30</b>
<b>Annex B</b> (normative)	<b>Determination of the liquid pump efficiency</b>	<b>36</b>
<b>Annex C</b> (informative)	<b>Examples of set of bin hours and hours for active mode, thermostat-off mode, standby mode, off mode and crankcase heater mode</b>	<b>40</b>
<b>Annex D</b> (informative)	<b><math>S_{COP,on}</math> and <math>S_{COP,net}</math> calculation for fixed capacity for 35 °C temperature application — Example</b>	<b>42</b>
<b>Annex E</b> (informative)	<b><math>S_{COP,on}</math> and <math>S_{COP,net}</math> calculation for variable capacity unit for 35 °C temperature application — Example</b>	<b>46</b>
<b>Bibliography</b>		<b>50</b>

## 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 document 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)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of 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 [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 21978:2021), which has been technically revised.

The main changes are as follows:

- values of uncertainties have been corrected;
- descriptive terms or names have been revised following ISO/IEC Directives;
- errors in [Annex A](#) have been corrected;
- typos have been corrected.

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).

## Introduction

Air to water heat pumps are, at present, selected and compared at a rated condition. This condition does not represent the usual operating conditions of the equipment over a season. This operating condition can be better assessed by comparing equipment at representative reduced capacities and determining the seasonal coefficient of performance.

This document provides part load conditions and calculation methods for calculating the seasonal coefficient of performance ( $S_{COP,on}$  and  $S_{COP,net}$ ) of such units when they are used to fulfil the heating demands.

Other energy consumptions can occur when the unit is not used to fulfil the heating demands such as those from a crankcase heater or when the unit is on standby. These consumptions are considered in the calculation methods for reference  $S_{COP}$ .

Reference  $S_{COP}/S_{COP,on}/S_{COP,net}$  calculations may be based on calculated or tested values. For the purpose of  $S_{COP}/S_{COP,on}/S_{COP,net}$ , three design conditions average (A), colder (C) and warmer (W) are considered, as well as three temperature applications. In case of tested values, this document gives the methods for testing air to water heat pumps at part load conditions.

# Air to water heat pumps — Testing and rating at part load conditions and calculation of seasonal coefficient of performance for space heating

## 1 Scope

This document specifies test conditions for determining the seasonal performance characteristics of air to water heat pumps for space heating with electrically driven compressors with or without supplementary heater. In the case of air to water heat pumps for space heating consisting of several parts with refrigerant or water connections, this document applies only to those designed and supplied as a complete package.

The seasonal coefficient of performance depends, inter alia, on the climate conditions and temperature regime of the space heating distribution network.

This document specifies:

- three design conditions, each of them being characterized by a design temperature which represents the lowest temperature that can occur in that design condition;
- three water temperature distribution regimes, namely “temperature application” in the text.

This document also provides a full description of three heating seasons that can be used with the associated design conditions.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

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

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

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

### 3.1

#### 35 °C application

temperature application where an indoor heat exchanger water(brine) outlet temperature of 35 °C is met at design temperature

### 3.2

#### 45 °C application

temperature application where an indoor heat exchanger water(brine) outlet temperature of 45 °C is met at design temperature

### 3.3

#### 55 °C application

temperature application where an indoor heat exchanger water(brine) outlet temperature of 55 °C is met at design temperature