INTERNATIONAL STANDARD

ISO
16358-3

First edition
2013-04-15

Air-cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors —

Part 3:
Annual performance factor

Climatiseurs à condenseur à air et pompes à chaleur air/air — Essais et méthodes de calcul des coefficients de performance saisonniers —

Partie 3: Coefficient de performance annuel (COPA)

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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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 6, *Testing and rating of air-conditioners and heat pumps*.

The parts of ISO 16358 are given below:

— *Part 1: Cooling seasonal performance factor*

— *Part 2: Heating seasonal performance factor*

— *Part 3: Annual performance factor*

Air-cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors —

Part 3:
Annual performance factor

1 Scope

1.1   This part of ISO 16358 specifies the testing and calculating methods for seasonal performance factor of equipment covered by ISO 5151, ISO 13253 and ISO 15042.

1.2   This part of ISO 16358 also specifies the seasonal performance test conditions and the corresponding test procedures for determining the seasonal performance factor of equipment, as specified in 1.1., under mandatory test conditions and is intended for use only in marking, comparison, and certification purposes.

1.3   This part of ISO 16358 does not apply to the testing and rating of:

a)   water-source heat pumps or water-cooled air conditioners;

b)   portable units having a condenser exhaust duct;

c)   individual assemblies not constituting a complete refrigeration system; or

d)   equipment using the absorption refrigeration cycle.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5151, *Non-ducted air conditioners and heat pumps — Testing and rating for performance*

ISO 13253, *Ducted air-conditioners and air-to-air heat pumps — Testing and rating for performance*

ISO 15042, *Multiple split-system air-conditioners and air-to-air heat pumps — Testing and rating for performance*

ISO 16358-1, *Air-cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors — Part 1: Cooling seasonal performance factor*

ISO 16358-2, *Air-cooled air conditioners and air-to-air heat pumps — Testing and calculating methods for seasonal performance factors — Part 2: Heating seasonal performance factor*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5151, ISO 13253, ISO 15042 and the following apply.

3.1
cooling seasonal total load
CSTL
total annual amount of heat that is removed from the indoor air when the equipment is operated for cooling in active mode

3.2
cooling seasonal energy consumption
CSEC
total annual amount of energy consumed by the equipment when it is operated for cooling in active mode

3.3
cooling seasonal performance factor
CSPF
ratio of the total annual amount of heat that the equipment can remove from the indoor air when operated for cooling in active mode to the total annual amount of energy consumed by the equipment during the same period

3.4
heating seasonal total load
HSTL
total annual amount of heat, including make-up heat, which is added to the indoor air when the equipment is operated for heating in active mode

3.5
heating seasonal energy consumption
HSEC
total annual amount of energy consumed by the equipment, including make-up heat, when it is operated for heating in active mode

3.6
annual performance factor
APF
ratio of the total annual amount of heat that the equipment can remove from and add to the indoor air when operated for cooling and heating, respectively, in active mode to the total annual amount of energy consumed by the equipment during the same period

3.7
total annual performance factor
TAPF
ratio of the total annual amount of heat that the equipment can remove from and add to the indoor air to the total annual amount of energy consumed by the equipment, including the active, inactive and disconnected modes

3.8
active mode
mode corresponding to the hours with cooling and heating demand of the building and whereby the cooling or heating function of the unit is switched on

3.9
inactive mode
mode corresponding to the hours when the unit is not operating to meet cooling or heating demand

Note 1 to entry: This mode may include the operation of a crankcase heater.

3.10
disconnected mode
mode corresponding to the hours when the unit is electrically disconnected from the main power supply

Note 1 to entry: Power consumption is zero.

4   Symbols

Symbol	Description	Unit
C_{CSE}	cooling seasonal energy consumption (CSEC)	Wh
C_{HSE}	heating seasonal energy consumption (HSEC)	Wh
F_{AP}	annual performance factor (APF)	—
F_{CSP}	cooling seasonal performance factor (CSPF)	—
F_{TAP}	total annual performance factor (TAPF)	—
L_{CST}	cooling seasonal total load (CSTL)	Wh
L_{HST}	heating seasonal total load (HSTL)	Wh

5   Calculation of annual performance factor (APF) and total annual performance factor (TAPF)

Annual performance factor (APF), F_{AP}, shall be calculated by Formula (1).

$$F_{AP} = \frac{L_{CST} + L_{HST}}{C_{CSE} + C_{HSE}} \tag{1}$$

Calculation of L_{CST} and C_{CSE} is according to ISO 16358-1, and calculation of L_{HST} and C_{HSE} is according to ISO 16358-2.

For the cooling-only equipment, the annual performance factor (APF) shall be equal to the cooling seasonal performance factor (CSPF).

In case of calculating the total annual performance factor (TAPF), refer to Annex A.

6   Test report

The test report for this part of ISO 16358 shall include the calculation of APF (and TAPF if applicable) and test reports from ISO 16358-1 for cooling and ISO 16358-2 for heating.

Annex A
(informative)

Calculation of total annual performance factor (TAPF)

A.1 General

This annex applies only to the reverse cycle units.

A.2 Measurement of the electric power consumption during the inactive mode

The unit shall be electrically connected to the main power source after shut-down for 6 h. Indoor and outdoor temperature of 20 °C condition shall be reached. The power consumption shall be measured for one hour after the temperature conditions are stabilized. The same test is repeated with the temperature condition of 5 °C, 10 °C and then 15 °C with the stabilization period of 2 h between each test. As a reference case, each power consumption value shall be weighted by weighting factors in Table A.1 and then integrated to obtain a weighted average inactive power consumption, P_{ia}. The calculation of inactive power may also be undertaken for other climate conditions and operating schedules.

NOTE   If the results of the tests at 20 °C and 5 °C are within 5 % or 1 W, then the tests at 15 °C and 10 °C are not mandatory. The average value of these results is used for the four considered temperature conditions.

Table A.1 — Default weighting factors for determination of reference inactive energy consumption

Temperature condition	5 °C	10 °C	15 °C	20 °C
Weighting factor	0,05	0,13	0,27	0,55

Inactive energy consumption (IAEC) shall be calculated by Formula (A.1).

$$C_{IAE} = H_{ia} \times P_{ia} \tag{A.1}$$

where

C_{IAE} is the inactive energy consumption;

H_{ia} is the number of hours of inactive mode as given in Table A.2;

P_{ia} is the weighted average power consumption.

A.3 Calculation of total annual performance factor (TAPF)

Total annual performance factor (TAPF), F_{TAP}, shall be calculated by Formula (A.2).

$$F_{TAP} = (L_{CST} + L_{HST}) / (C_{CSE} + C_{HSE} + C_{IAE}) \tag{A.2}$$

Calculation of L_{CST} and C_{CSE} is according to ISO 16358-1, and calculation of L_{HST} and C_{HSE} is according to ISO 16358-2.

Inactive energy consumption (IAEC), C_{IAE}, shall be calculated by Formula (A.1).

The default mode hours for the calculation of reference total annual performance factor are shown in Table A.2. The calculation of total annual performance factor may also be undertaken for other distributions of mode hours.

Table A.2 — Default hours by mode for the calculation of reference total annual performance factor

	Active mode h	Inactive mode, H_{ia} h	Disconnected mode h
Cooling season	1 817	—	—
Heating season	2 866	—	—
Annual total hours	4 683	4 077	0

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