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Multiple split-system air conditioners and air-to-air heat pumps — Testing and rating for performance

Climatiseurs et pompes à chaleur air/air multi-split — Essais et détermination des caractéristiques de performance

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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).

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.

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 15042:2011), which has been technically revised.

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Multiple split-system air conditioners and air-to-air heat pumps — Testing and rating for performance

1 Scope

This document specifies the performance testing, the standard conditions and the test methods for determining the capacity and efficiency ratings of air-cooled air conditioners and air-to-air heat pumps.

This document is applicable to the following equipment:

— basic multi-split systems, modular multi-split systems and modular heat recovery multi-split systems. These multi-split systems include air-to-air systems with non-ducted and/or ducted indoor units with integral fans and indoor units supplied without fans.

This document is limited to:

— residential, commercial and industrial split-system air conditioners and heat pumps;

— factory-made, electrically driven and use mechanical compression;

— single- and multiple-circuit split-systems which utilize one or more compressors with no more than two steps of control of the outdoor unit;

or

— split-systems with a single refrigeration circuit which utilize one or more variable-speed compressors or alternative compressor combinations for varying the capacity of the system by three or more steps.

These split-systems are designed to operate with a combination of one or more outdoor units and two or more indoor units designed for individual operation, and such modular systems are capable of transferring recovered heat from one or more indoor units to other units in the same system.

The requirements of testing and rating contained in this document are based on the use of matched assemblies.

This document is not applicable to the rating and testing of the following:

a) water-cooled or water source equipment;

b) mobile (single-duct) units having a condenser exhaust duct;

c) individual assemblies not constituting a complete refrigeration system;

d) equipment using the absorption refrigeration cycle.

e) ducted air conditioners and/or ducted heat pumps, rated at less than 8 kW and intended to operate at external static pressures of less than 25 Pa, controlled by a single thermostat/controller (refer to ISO 5151);

f) multiple split-system utilizing one or more refrigeration systems, one outdoor unit and one or more indoor units, controlled by a single thermostat/controller (refer to ISO 5151 or ISO 13253).

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This document does not cover the determination of seasonal efficiencies or seasonal part-load performances, which can be required in some countries because they provide a better indication of efficiency under actual operating conditions.

NOTE Throughout this document, the terms “equipment” and “systems” mean “multi-split air conditioners” and/or “multi-split heat pumps”.

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*

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

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

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

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
standard air
dry air at 20 °C and at a standard barometric pressure of 101,325 kPa, having a mass density of 1 204 kg/m^3

3.2
full capacity
capacity of the system when all indoor units and outdoor units are operated in the same mode

3.3
latent cooling capacity
room dehumidifying capacity
amount of latent heat that the equipment can remove from the conditioned space in a defined interval of time

Note 1 to entry: Latent cooling capacity and room dehumidifying capacity are expressed in units of watts.

3.4
part-load capacity
capacity of the system when the capacity ratio is less than 1

3.5
capacity ratio
ratio of the total stated cooling capacity of all operating indoor units to the stated cooling capacity of the outdoor unit at the rating conditions

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3.6
heating capacity
amount of heat that the equipment can add to the conditioned space (but not including supplementary heat) in a defined interval of time

Note 1 to entry: Heating capacity is expressed in units of watts.

3.7
sensible cooling capacity
amount of sensible heat that the equipment can remove from the conditioned space in a defined interval of time

Note 1 to entry: Sensible cooling capacity is expressed in units of watts.

3.8
total cooling capacity
amount of sensible and latent heat that the equipment can remove from the conditioned space in a defined interval of time

Note 1 to entry: Total cooling capacity is expressed in units of watts.

3.9
energy efficiency ratio
EER
ratio of the total cooling capacity to the effective power input to the device at any given set of rating conditions

Note 1 to entry: Where the EER is stated without an indication of units, it is understood that it is derived from watts/watts.

3.10
coefficient of performance
COP
ratio of the heating capacity to the effective power input to the device at any given set of rating conditions

Note 1 to entry: Where the COP is stated without an indication of units, it is understood that it is derived from watts/watts.

3.11
heat recovery efficiency
HRE
ratio of the total capacity of the system (heating and cooling capacity) to the effective power when operating in the heat recovery mode

Note 1 to entry: Where HRE is stated without an indication of units, it is understood that it is derived from watts/watts.

3.12
air conditioner
encased assembly or assemblies designed primarily to provide free or ducted delivery of conditioned air to an enclosed space room or zone (conditioned space)

Note 1 to entry: It can be either single-package or split-system and comprises a primary source of refrigeration for cooling and dehumidification. It can also include means for heating other than a heat pump, as well as means for circulating, cleaning, humidifying, ventilating or exhausting air. Such equipment can be provided in more than one assembly, the separated assemblies (split-systems) of which are intended to be used together.

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3.13
heat pump
encased assembly or assemblies designed primarily to provide free or ducted delivery of conditioned air to an enclosed space, room or zone (conditioned space) and includes a prime source of refrigeration for heating

Note 1 to entry: It can be constructed to remove heat from the conditioned space and discharge it to a heat sink if cooling and dehumidification are desired from the same equipment. It can also include means for circulating, cleaning, humidifying, ventilating or exhausting air. Such equipment can be provided in more than one assembly, the separated assemblies (split-systems) of which are intended to be used together.

3.14
basic multi-split system
split-system air conditioner or heat pump incorporating a single refrigerant circuit with one or more compressors, multiple evaporators (indoor units) designed for individual operation, and one outdoor unit

Note 1 to entry: The system has no more than two steps of control and is capable of operating either as an air conditioner or as a heat pump. Alternatively, a system having a variable speed compressor and a fixed combination of indoor units specified by the manufacturer can also be considered a basic multi-split system.

3.15
multiple-circuit multi-split system
split-system air conditioner or heat pump incorporating multiple refrigerant circuits, two or more compressors, multiple evaporators (indoor units) and an integrated heat exchanger in a single outdoor unit

Note 1 to entry: The system has no more than two steps of control and is capable of operating either as an air conditioner or as a heat pump.

3.16
modular multi-split system
split-system air conditioner or heat pump incorporating a single refrigerant circuit, at least one variable speed compressor or an alternative compressor combination for varying the capacity of the system by three or more steps, multiple indoor units, each of which can be individually controlled, and one or more outdoor units

Note 1 to entry: The system is capable of operating either as an air conditioner or as a heat pump

3.17
modular heat recovery multi-split system
split-system air conditioner or heat pump incorporating a single refrigerant circuit, at least one variable-speed compressor or an alternate compressor combination for varying the capacity of the system by three or more steps, multiple evaporators (indoor units, each capable of being individually controlled), and one or more condensers (outdoor units)

Note 1 to entry: This system is capable of operating as a heat pump where recovered heat from the indoor units operating in the cooling mode can be transferred to one or more other indoor units operating in the heating mode. Heat recovery can be achieved by a gas/liquid separator or a third line in the refrigeration circuit.

3.18
effective power input
P_E
average electrical power input to the equipment obtained from

— the power input for operation of the compressor(s),

— the power input to electric heating devices used only for defrosting,

— the power input to all control and safety devices of the equipment, and

— the power input for operation of all fans, whether provided with the equipment or not

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Note 1 to entry: Effective power input is expressed in units of watts.

3.19
total power input
P_t
average electrical power input to the equipment as measured during the test

Note 1 to entry: Total power input is expressed in units of watts

3.20
full-load operation
operation with the equipment and controls configured for the maximum continuous duty refrigeration capacity specified by the manufacturer and allowed by the unit controls

Note 1 to entry: Unless otherwise regulated by the automatic controls of the equipment, all indoor units and compressors are functioning during full-load operations.

4 Symbols

Symbol	Description	Unit
A_l	coefficient, heat leakage	J/(s·K)
A_n	nozzle area	m^2
C_d	nozzle discharge coefficient	—[a]
c_{pa1}	specific heat of moist air entering indoor-side[b]	J/(kg[b]·K)
c_{pa2}	specific heat of moist air leaving indoor-side[b]	J/(kg[b]·K)
c_{pa3}	specific heat of moist air entering outdoor side[b]	J/(kg[b]·K)
c_{pa4}	specific heat of moist air leaving outdoor side[b]	J/(kg[b]·K)
c_{pw}	specific heat of water	J/(kg[b]·K)
D_e	equivalent diameter	m
D_i	diameter of circular ducts, inlet	m
D_n	nozzle throat diameter	m
D_o	diameter of circular ducts, outlet	m
D_t	outside diameter of refrigerant tube	m
h_{a1}	specific enthalpy of air entering indoor-side	J/kg[b]
h_{a2}	specific enthalpy of air leaving indoor-side	J/kg[b]
h_{a3}	specific enthalpy of air entering outdoor side	J/kg[b]
h_{a4}	specific enthalpy of air leaving outdoor side	J/kg[b]
h_{f1}	specific enthalpy of refrigerant liquid entering expansion device	J/kg
h_{f2}	specific enthalpy of refrigerant liquid leaving condenser	J/kg
h_{g1}	specific enthalpy of refrigerant vapour entering compressor	J/kg
h_{g2}	specific enthalpy of refrigerant vapour leaving compressor	J/kg
h_{r1}	specific enthalpy of refrigerant entering indoor-side	J/kg
h_{r2}	specific enthalpy of refrigerant leaving indoor-side	J/kg
h_{w1}	specific enthalpy of water or steam supplied to indoor-side test chamber	J/kg
h_{w2}	specific enthalpy of condensed moisture leaving indoor-side test chamber	J/kg

[a] Dimensionless value.

[b] It means the mass of dry air; the mass, kg of denominator in this unit is based on dry air (or DA). For units practically used in the air conditioning field, "kg(DA)" is very often used as the denominator.

Example: J/kg(DA), m^3/kg(DA), kg/kg(DA).

NOTE All parameters are in relation to the unit being tested unless specified otherwise.

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