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Ducted air-conditioners and air-to-air heat pumps — Testing and rating for performance

Climatiseurs et pompes à chaleur air/air raccordés — Essais et détermination des caractéristiques de performance

[Revision of first edition (ISO 13253:1995)]

ICS 23.120; 27.080

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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.
International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3. 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.
International Standard ISO 13253 was prepared by Technical Committee TC 86, *Refrigeration and Air-conditioning*, SC 6, *Factory-made air-conditioning and heat pump units*., Working Group WG 1 in 1994.
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Ducted air-conditioners and air-to-air heat pumps — Testing and rating for performance

1 Scope

1.1 This International Standard specifies the standard conditions on which the capacity and efficiency ratings of factory-made residential, commercial and industrial, electrically-driven, mechanical-compression, single-package and split-system, ducted air conditioners employing air- and water-cooled condensers and ducted heat pumps employing air-cooled condensers are based. The International Standard also specifies the test methods to be applied for determining the capacity and efficiency ratings. This International Standard covers equipment utilizing one or more refrigeration systems, one outdoor unit and one or more indoor units controlled by a single thermostat/controller. This International Standard covers equipment utilizing single, multiple and variable capacity components.

NOTE: For the purpose of this International Standard, the term “equipment” is used to mean “ducted air-conditioners and/or ducted heat pumps.”

1.2 This International Standard also specifies standard performance test conditions and the corresponding test procedures for determining performance characteristics of these ducted air conditioners and heat pumps.

1.3 This International Standard does not apply to the testing and rating of:

a) multi-split system[1)] air conditioners and air-to-air heat pumps;
b) individual assemblies not constituting a complete refrigeration system;

[1)] Systems having a single outdoor unit and two or more indoor units, each indoor unit being independently controlled (see ISO 15042).

c) equipment using the absorption refrigeration cycle;
d) non-ducted air conditioners or non-ducted heat pumps;
e) water-source heat pumps.
f) ducted air conditioners and heat pumps rated at less than 8kW and intended to operate at an external static pressure of less than 25 Pa (Such equipment shall be tested according to ISO 5151)

1.4 This International Standard does not cover the determination of seasonal efficiencies which may be required in some countries because they provide a better indication of efficiency under actual operating conditions.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard:

ISO 817, *Refrigerants — Number designation.*

3 Definitions

For the purposes of this International Standard, the following definitions apply (see Annex R for the symbols used to identify the terms contained in this International Standard):

3.1 ducted air conditioner

An encased, factory-made assembly or assemblies designed to be used as permanently installed equipment to provide conditioned air to enclosed space(s) through a duct. It includes a prime source of refrigeration for cooling and dehumidification and may include means for heating, humidifying, ventilating, exhausting and cleaning the air. It normally includes an evaporator, compressor and condenser. Such equipment may be provided in more than one assembly, the separated assemblies of which, are intended to be used together.

3.2 ducted heat pump

An encased, factory-made assembly or assemblies designed to be used as permanently installed equipment to take heat from a heat source and deliver it to the conditioned space through a duct when heating is desired. It may 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 normally includes an indoor conditioning coil, a compressor and an outdoor coil. Such equipment may be provided in more than one assembly, the separated assemblies of which, are intended to be used together. The equipment may also provide the functions of air cleaning, circulating and humidifying.

3.3 standard air

Dry air at 20,0EC and at a standard barometric pressure of 101,325 kPa, having a mass density of 1,204 kg/m^3.

3.4 total cooling capacity

Amount of sensible and latent heat that the equipment can remove from the conditioned space in a defined interval of time, expressed in watts.

3.5 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, expressed in watts.

3.6 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, expressed in 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, expressed in watts.

3.8 sensible heat ratio

Ratio of sensible cooling capacity to the total cooling capacity.

3.9 rated voltages(s)

Voltage(s) shown on the nameplate of the equipment.

3.10 rated frequency(ies)

Frequency(ies) shown on the nameplate of the equipment.

3.11 energy efficiency ratio (EER)

Ratio of the total cooling capacity to the effective power input to the equipment at any given set of rating conditions. (Where the EER is stated without an indication of units, it shall be understood that it is derived from watts/watt.)

3.12 coefficient of performance (COP)

Ratio of the heating capacity to the effective power input to the equipment at any given set of rating conditions. (Where COP is stated without an indication of units, it shall be understood that it is derived from watts/watt.)

3.13 effective power input (P_E)

Average electrical power input to the equipment, expressed in watts and obtained from:

- the power input for operation of the compressor;
- 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 and, if applicable, any water-cooled condenser pump(s), corrected as required in this standard.

3.14 total power input (P_t)

The average electrical power input to the equipment as measured during the test, expressed in watts.

3.15 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. Unless otherwise regulated by the automatic controls of the equipment, all indoor units and compressors shall be functioning during full-load operations.

4. Air Flow.

4.1 General

The volume flow and the pressure difference shall be related to standard air and with dry evaporator

4.2 Indoor Air Flow Setting.

The air flow rate given by the manufacturer shall be converted into standard air conditions. The air flow rate setting shall be made when the fan only is operating,and at an ambient dry-bulb temperature from 20 to 30 C and wet-bulb 13 to 17C with a relative humidity from 30% to 70%.
The rated airflow rate given by the manufacturer shall be set and the resulting external static pressure (ESP) measured. This ESP shall be greater than the minimum value given in Table 1 but not greater than 80% of the maximum external static pressure specified by the manufacturer.
If the fan of the unit has an adjustable speed, it shall be adjusted to the lowest speed that provide the minimum ESP or greater.
If the maximum ESP of the unit is lower than the minimum ESP given in Table 1, then the air flow rate is lowered to achieve an ESP equal to 80% of the maximum ESP of the manufacturer.
In case this ESP is lower than 25 Pa, the unit can be considered as a free delivery unit and be tested in accordance with ISO 5151.

Table 1 — Pressure requirement for comfort air conditioners

Standard capacity ratings	Minimum external static pressure [a]

kW	Pa
0 < Q < 8	25
8 ≤ Q < 12	37
12 ≤ Q < 20	50
20 ≤ Q < 30	62
30 ≤ Q < 45	75
45 ≤ Q < 82	100
82 ≤ Q < 117	125
117 ≤ Q < 147	150
Q > 147	175
[a] For equipment tested without an air filter installed, the minimum external static pressure shall be increased by 10 Pa.	

4.3 Outdoor Air Flow

If the outdoor airflow is adjustable, all tests shall be conducted at the outdoor-side air quantity or fan control setting that is specified by the manufacturer. Where the fan is non-adjustable, all tests shall be conducted at the outdoor-side air volume flow rate inherent in the equipment when operated with the following in place: all of the resistance elements associated with inlets, louvers, and any ductwork and attachments considered by the manufacturer as normal installation practice. Once established, the outdoor-side air circuit of the equipment shall remain unchanged throughout all tests prescribed herein, except to adjust for any change caused by the attachment of the air-flow measuring device when using the outdoor air-enthalpy test method (see G.2.1).

4.4 Test Method.

4.4.1 The air flow settings of the units shall be in accordance with Annex A.

4.5 Unit without indoor fan.

If no fan is supplied with the unit i.e. coil only units, the requirements in Annex A and the supplemental requirements given in Annex P also apply.

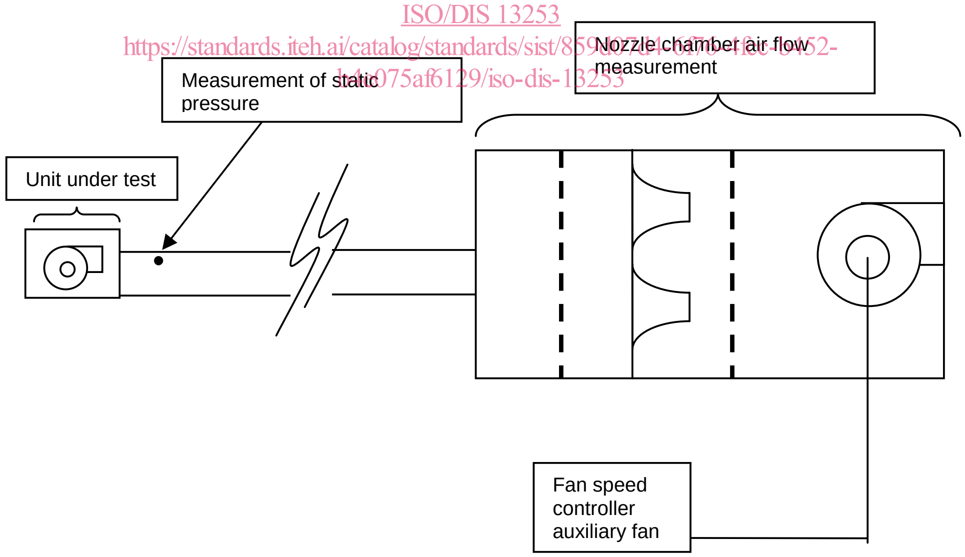

Figure 1 Arrangement of Auxiliary Fan Set Up.

5 Cooling tests

5.1. Cooling capacity tests and ratings

5.1.1 General conditions

All equipment within the scope of this International Standard shall have the cooling capacities and energy efficiency ratios determined in accordance with the provisions of this International Standard and rated at the cooling test conditions specified in Table 2. All tests shall be carried out in accordance with the requirements of Annex B and the test methods specified in Clause 6. All tests shall be conducted with the equipment functioning at full-load operation, as defined by 3.15. The electrical input values used for rating purposes shall be measured during the cooling capacity test

(NOTE: All air flow rates shall be expressed in units of m^3/s of standard air. The cooling capacity calculations described in Annex D require the indoor-side air flow rate to be expressed in units of m^3/s of the air-water vapour mixture.)

5.1.2Temperature conditions

5.1.2.1 The temperature conditions stated in Table 2, Columns T1, T2 and T3, shall be considered standard rating conditions for the determination of cooling capacity. For equipment intended for space cooling, testing shall be conducted at one or more of the standard rating conditions specified in Table 2.

Table 2 — Cooling capacity rating conditions

Parameter	Standard rating test conditions T1 (Moderate Climates)	T2 (Cool Climates)	T3 (Hot Climates)
Temperature of air entering indoor-side: dry-bulb wet-bulb	 27 ^{0}C 19 ^{0}C	 21 ^{0}C 15 ^{0}C	 29 ^{0}C 19 ^{0}C
Temperature of air entering outdoor-side: dry-bulb wet-bulb[1)]	 35 ^{0}C 24 ^{0}C	 27 ^{0}C 19 ^{0}C	 46 ^{0}C 24 ^{0}C
Condenser water temperature[2)] : inlet outlet	 30 ^{0}C 35 ^{0}C	 22 ^{0}C 27 ^{0}C	 30 ^{0}C 35 ^{0}C
Test frequency[3)]	Rated frequency		
Test voltage	See Table 2		

T1 = Standard cooling capacity rating conditions for **moderate** climates.

T2 = Standard cooling capacity rating conditions **cool** climates

T3 = Standard cooling capacity rating conditions for **hot** climates

1) The wet-bulb temperature condition shall only be required when testing air-cooled condensers that evaporate the condensate.

2) Representative of equipment with cooling towers. For equipment designed for other uses, the manufacturer shall designate the condenser water inlet and outlet temperatures or the water flow rates and the inlet water temperature in the ratings.

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

5.1.2.2 Equipment manufactured only for use in a **moderate** climate similar to that specified in Table 2, Column T1, shall have ratings determined by tests conducted at Table 2 – T1 conditions and shall be designated type T1 equipment.

5.1.2.3 Equipment manufactured only for use in a **cool** climate similar to that specified in Table 2, Column T2, shall have ratings determined by tests conducted at Table 2 – T2 conditions and shall be designated type T2 equipment.

5.1.2.4 Equipment manufactured only for use in a **hot** climate similar to that specified in Table 2, Column T3, shall have ratings determined by tests conducted at Table 2 – T3 conditions and shall be designated type T3 equipment.

5.1.2.5 Equipment manufactured for use in more than one of the climates defined in Table 2 shall have marked on the nameplate the designated type (T1, T2 and/or T3). The corresponding ratings shall be determined by tests at the standard rating conditions specified in Table 2.

Table 3 — Voltages for capacity and performance tests

(except the maximum cooling and the maximum heating tests)

Rated (nameplate) voltages[1)]	Test voltage
90 to 109	100
110 to 127	115
180 to 207	200
208 to 253	230
254 to 341	265
342 to 420	400
421 to 506	460
507 to 633	575

1) For equipment with dual-rated voltages such as 115/230 and 220/440, the test voltages would be 115 and 230 volts in the first example, and 230 and 460 volts in the second example. For equipment with an extended voltage range, such as 110-120 volts or 220-240 volts, the test voltage would be 115 volts or 230 volts, respectively. Where the extended voltage range spans two or more of the rated voltage ranges, the mean of the rated voltages shall be used to determine the test voltage from the table. (EXAMPLE: For equipment with an extended voltage range of 200-220 volts, the test voltage would be 230 volts, based on the mean voltage of 210 volts)

5.1.3 Test conditions

5.1.3.1 Preconditions

The test room reconditioning apparatus and the equipment under test shall be operated until equilibrium conditions, as required by 6.3, are attained. Equilibrium conditions shall be maintained for not less than one hour before capacity test data are recorded.

5.1.3.2 Duration of test

The data shall be recorded at equal intervals that span five minutes or less. The recording of the
data shall continue for at least a 30-minute period during which the tolerances specified in 6.3 shall be met.

5.2 Maximum cooling test

5.2.1 General conditions

The conditions which shall be used during the maximum cooling test are given in Table 4. The test shall be conducted with the equipment functioning at full-load operation, as defined in 3.15. The test voltages in Table 4 shall be maintained at the specified percentages under running conditions. In addition, the test voltage shall be adjusted so that it is not less than 86% of the rated voltage at the moment of restarting the equipment after the shutdown required by 5.2.4.2. The determination of cooling capacity and electrical power input is not required for this performance test.

5.2.2 Temperature conditions

Tests shall be carried out under the conditions given in Column T1, T2 or T3 of Table 4, based on the intended use, as determined in 5.1.2. For equipment rated for use under more than one set of operating conditions, the most stringent set of the intended operating conditions shall be applied for test purposes.