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Room fan-coil units — Testing and rating for performance

Évaporateurs individuels à ventilation forcée — Essais et détermination des caractéristiques de performance

ICS 23.120

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Contents

Foreword

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The main task of technical committees is to prepare International Standards. 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.

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ISO was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 6, *Factory-made air-cooled air-conditioning and air-to-air heat pump units*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

Room fan-coil units — Testing and rating for performance

1 Scope

This International Standard applies to factory-made assemblies, which provide the functions of cooling and/or heating but do not include the source of cooling or heating. These units are normally designed for free delivery of air into a room, but may be installed with minimal duct work having a static resistance generally not exceeding 65 Pa [0,26 in wg] and a maximum air flow of 0,7 m^3/s [1,483.2 cfm].

This International Standard provides for the use of hot or chilled water in determining the thermal performance of room fan-coil units at standard rating conditions. The test procedures contained in this international standard may additionally be used for determining performance at other conditions.

This International Standard does not cover the rating of heating or cooling from direct expansion coils or heating from electric resistance elements.

NOTE For the purposes of the remaining clauses, the terms “unit” and “equipment” are used to mean “room fan-coil units” as defined in 3.1.

NOTE SI units are provided in the standard as a normative absolute, and I-P are provided as a reference only.

2 Normative references

The following referenced documents are indispensable for the application 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 5221-1984, *Air distribution and air diffusion – Rules to methods of measuring air flow rate in an air handling duct*

ISO 5801-2007, *Industrial fans – Performance testing using standardized airways*

ISO 5167-1-1991, *Measurement of fluid flow by means of pressure differential devices: Part 1: Orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full*

ISO 5167-1 FDA1, Amendment 1, 1997

EN 1397-1999, *Heat exchangers – Hydronic room fan coil units – Test procedure for establishing the performance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply / the terms and definitions given in … and the following apply.

3.1 cooling capacity

3.1.1
latent cooling capacity
heat which is removed from the air by condensation of water vapour on the cooling coil.

3.1.2
sensible cooling capacity
heat which is removed from the air by the unit as measured by a dry-bulb temperature change.

3.1.3
total cooling capacity
total heat removal capacity from the air; the sum of the sensible and latent heat removal capacity.

3.2
heating capacity
total heat added to the air by the unit.

3.3
room fan-coil unit
factory-made single assembly which provides one or more of the functions of forced circulation of air, heating, cooling, dehumidification and filtering of air, but which does not include the source of heating or cooling. This device is designed for free intake of air from a room and delivery of that air back into the same room, but may be applied with minimal ductwork. This device may also be designed for built-in (furred-in) applications, or within an enclosure for application within the conditioned space. This device employs only direct drive mechanisms for the fan.

3.4
standard air
dry air at 20,0 °C [68,0 °F] and at a standard barometric pressure of 101,325 kPa [406,782 in wg], having a mass density of 1,204 kg/m3 [0,0752 lb/ft3].

4 Standard rating tests

4.1 Cooling capacity ratings

4.1.1 General conditions

4.1.1.1 The air filter and any air mixers, air-inlets, grilles, deflecting vanes, and any other regularly provided equipment shall be in place during the tests. Valve packages shall not be included in the tests.

4.1.2 Testing conditions

4.1.2.1 The cooling capacities shall be determined in accordance with the testing conditions specified in Table 1. The water flow rates shall be those necessary to maintain the standard rating conditions established in Table 1.

4.1.3 Air flow conditions

4.1.3.1 In establishing air flow conditions for fan-coil units, there shall be no water flow through the coil. Free delivery fan-coil units shall be tested at the highest fan setting, with the outside air dampers closed, and a zero external static pressure. Built-in fan-coil units which are supplied by the manufacturer without a filter or grilles, or both, as part of the unit shall be tested with an external static pressure of either 12,5 Pa [0,050 in wg] or 50 Pa [0,20 in wg], as specified by the manufacturer in the manufacturers' equipment specification sheets. The external static pressure is set with dry coil and will be allowed to slightly change during the cooling capacity test but will remain in accordance with Table 4 and Table 5.

4.2 Heating capacity ratings

4.2.1 General conditions

The general conditions established in 4.1.1 for cooling capacity rating tests shall apply to the heating capacity rating tests.

4.2.2 Testing conditions

The heating capacities shall be determined in accordance with the testing conditions specified in Table 1. The water flow rate shall be derived from the information provided in Table 1. The air flow conditions for the heating capacity test shall be those established in 4.1.3 for the cooling capacity test.

Table 1 – Cooling and heating capacity test conditions

Test Conditions	Cooling Capacity	Heating Capacity	
	2 Pipe and 4 Pipe	2 Pipe System	4 Pipe System
Temperature of air entering unit-dry bulb, t_{a1}	27 °C [81 °F]	20 °C [68 °F]	20 °C [68 °F]
Temperature of air entering unit-wet bulb, t'_{a1}	19 °C [66 °F]	Max 15 °C [59 °F]	Max 15 °C [59 °F]
Inlet water temperature, t_{w1}	7 °C [45 °F]	45 °C [113 °F]	70 °C [158 °F]
Outlet water temperature, t_{w2}	12 °C [54 °F]	[a]	60 °C [140 °F]
Water flow, Q_w	---	Same as cooling capacity	---
Test frequency – Rated frequency [b]			
NOTE 1 For Test Voltage see Table 2.			

[a] Outlet water temperature is not fixed, but is a result of flow rate determined by cooling test.

[b] Units with dual-rated frequencies shall be tested at each frequency.

Table 2 – Voltages for capacity and performance tests

Rated (Nameplate) Voltages	Test Voltage
90 to 109	100
110 to 127	115
180 to 205	200
206 to 217	208
218 to 253	230
254 to 341	265
342 to 420	400
421 to 506	460
507 to 633	575

4.3 Air flow ratings

4.3.1 General conditions

In establishing air flow ratings for fan-coil units, there shall be no water flow through the coil. The air flow rating test shall be conducted at the highest fan speed setting with the outside air dampers closed, and a zero external static pressure. Built-in fan-coil units which are supplied by the manufacturer without a filter or grilles,

or both, as part of the unit shall be tested with an external static pressure of either 12,5 Pa [0,050 in wg] or 50 Pa [0,2 in wg] as specified by the manufacturer in the manufacturer's equipment specification sheets. Air flow ratings shall be made in accordance with Annex D.

4.3.2 Temperature conditions

The inlet air dry bulb temperature shall be between 15 °C [59 °F] and 27 °C [81 °F]. Airflow rating is to be determined by correction to standard air conditions.

4.3.3 Electrical conditions

The fan-coil unit shall be tested at the test voltage specified in Table 2 and at the rated frequency.

5 Performance tests

5.1 Low-voltage test

5.1.1 General conditions

5.1.1.1 A room fan-coil unit shall be energized with the fan speed at the lowest setting. Water flow through the coils is not necessary for this test.

5.1.2 Performance requirement

5.1.2.1 The room fan-coil unit shall start and operate when energized at a voltage equal to 90 %, ± 1 % of the nameplate rating voltage. If a dual range is provided, the voltage shall be 90 percent of the lowest voltage. This test will be conducted with the unit not having being operated for at least the previous 12 hours, and at a laboratory temperature between 15 °C [59 °F] and 27 °C [81 °F].

5.2 Condensate control test

5.2.1 General conditions

The grilles, dampers, etc. shall be set to allow for the maximum cooling capacity.

5.2.2 Temperature conditions

The temperature conditions for the condensate control test are specified in Table 3.

5.2.3 Air flow conditions

5.2.3.1 The fan speed shall be set for the lowest fan speed setting. No external resistance shall be added at the air inlet or air outlet.

5.2.4 Test condition

The fan-coil units shall be tested as specified in Tables 3, 4 and 5. After reaching equilibrium at the specified temperature conditions, the unit shall be operated for a period of four hours.

5.2.5 Performance requirement

No condensed water shall drip, run or blow from the fan-coil unit such that the building or the surroundings become wet.

Table 3 – Condensate control test conditions

Parameter	Test conditions
Temperature of air entering unit:	
- dry bulb	27 °C [81 °F]
- wet bulb	24 °C [75 °F]
Temperature of water:	
- inlet flow	6 °C [43 °F]
- outlet flow	10 °C [50 °F]
Test frequency	Rated frequency[a]
Test voltage	See Table 2

[a] Dual-rated units shall be tested at the lowest frequency.

6 Test methods and uncertainties of measurement

6.1 Test Methods

6.1.1 General

The rating tests for determining the heating and cooling capacities of fan-coil units shall be conducted in accordance with the provisions of Annex A (input method). Annex B (output method) and Annex C (calorimeter method) are available confirming informative methods for use as needed.

6.1.2 The testing equipment used shall meet the requirements for uncertainty of measurements specified in Table 4.

6.1.3 The test observations for capacity tests shall be within the tolerances specified in Table 5. The maximum permissible variation of any observation during a test shall not exceed the value listed in Table 5. The maximum permissible variation of the mean of the test conditions from the specified test conditions shall not be more than that specified in Table 5.

6.2 Test duration

6.2.1 The duration of each test shall not be less than 30 minutes after thermal equilibrium has been attained. For the output measurement it is necessary to record all meaningful data continuously. In the case of recording instruments which operate on a cyclic basis, the sequence shall be adjusted such that a complete recording is effected at least once every 30s. The barometric pressure shall be recorded at least once during each test.

Table 4 – Uncertainties of measurements

Measured quantity	Uncertainty of measurement
Water	
temperature	± 0,10 °C [0,18 °F]
temperature difference	± 0,10 °C [0,18 °F]
volume flow	± 1 %
static pressure difference	± 5 %
Air	
dry-bulb temperature	± 0,20 °C [0,36 °F]
wet-bulb temperature	± 0,20 °C [0,36 °F]
volume flow	± 5 %
static pressure difference	± 5 %
Electrical inputs	± 1,0 %
Time	± 0,2 s or ± 0,2 % of reading whichever is smaller
Mass	± 0,5 %
Atmospheric pressure	± 0,5 kPa [2 in wg]
Condensate rate	± 1,0 %
Speed	± 1,0 %

Table 5 – Variations allowed in capacity test readings

Readings	Variations of arithmetical mean values from specified test conditions (±)	Maximum variation of individual readings from specified test conditions (±)
Temperature of air entering unit:		
dry-bulb	0,30 °C [0,54 °F]	1,0 °C [1,8 °F]
wet-bulb	0,20 °C [0,36 °F]	0,5 °C [0,9 °F]
Temperature of air exiting unit:		
dry-bulb	—	1,0 °C [1,8 °F]
wet-bulb	—	0,5 °C [0,9 °F]
Air volume flow rate	5%	10%
Voltage	1%	4%
Water temperature:		
inlet	0,10 °C [0,18 °F]	0,20 °C [0,36 °F]
outlet	0,10 °C [0,18 °F]	0,20 °C [0,36 °F]
Water volume flow rate	—	1%
External resistance to air-flow	5%	10%

7 Test results

7.1 General

The results of the capacity test shall express quantitatively the effects produced on the air by the equipment being tested. For the given test conditions, the capacity test results shall include the following quantities as applicable for the cooling or heating tests:

a) Total cooling capacity, kW [BTU/hr]

b) Sensible cooling capacity, kW [BTU/hr]

c) Latent cooling capacity, kW [BTU/hr]

d) Heating capacity, kW [BTU/hr]

e) Airflow rate, m3/s [cfm] of standard air

f) External resistance to airflow, Pa [in wg], set with dry coil

g) Water flow rate, l/s [gpm]

h) Water pressure drop, Pa [in wg]

i) Fan speed, rpm

j) Total power input to the unit, W [hp]

7.2 Calculations

The capacity calculations shall be made in accordance with the provisions of Annex A.

7.3 Data to be recorded

The data to be recorded are listed in Annex A, Annex B or Annex C.

8 Marking provisions

8.1 Nameplate requirements

A permanent nameplate shall be provided and located in an accessible position for reading the data after installation of the fan-coil unit.

8.2 Nameplate information

At a minimum, the nameplate shall be marked with the manufacturer's name, model designation, rated voltage and frequency.

9 Publication of ratings

9.1 Standard ratings

9.1.1 The manufacturer shall provide standard ratings which include the following information: