

2008 STANDARD FOR

Standard 440

Performance Rating of Room Fan-Coils



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IMPORTANT

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ISHRAE-ARI CERTIFICATION PROGRAM PROVISIONS

Scope of the Certification Program

The certification program includes Room Fan-Coils as defined in Section 3, having air-delivery capacities of $0.7080 \text{ m}^3/\text{s}$ [1500 cfm] or less.

Room Fan-Coils employing Volatile Refrigerant Coils or steam coils, central-station air-handling units as defined in **ISHRAE-ARI** Standard 430, and unit ventilators as defined in **ISHRAE-ARI** Standard 840 are not included.

Certified Ratings

The following certification program ratings shall be verified by test at the Standard Rating Conditions for Cooling Capacity (6.3.1), and for power input (6.3.4):

1. Total Cooling Capacity, W [Btu/h],
2. Sensible Cooling Capacity, W [Btu/h],
3. Power Input, W [W].

Conformance to the requirements of the insulation efficiency test and the low voltage test (8) shall also be verified by test.

Note:

This standard supersedes ARI Standard 440-98

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PERFORMANCE RATING OF ROOM FAN-COILS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to provide for Room Fan-Coils: definitions; classifications; test requirements; rating requirements; minimum data requirements for Published Ratings; operating requirements; marking and nameplate data; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This standard applies to Room Fan-Coils, defined in Section 3, having air-delivery capacities of $0.7080 \text{ m}^3/\text{s}$ [1500 cfm] or less.

2.2 *Exclusions.*

2.2.1 This standard does not apply to central-station air-handling units as defined in ISHRAE-ARI Standard 430.

2.2.2. This standard does not apply to unit ventilator units as defined in ISHRAE-ARI Standard 840.

2.2.3 This standard does not apply to Room Fan-Coils employing:

- a. volatile-refrigerant coils
- b. steam coils

Section 3. Definitions

Definitions. All terms in this document shall follow the standard industry definitions in the current edition of ASHRAE *Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* unless otherwise defined in this section.

3.1 *Capacity.*

3.1.1 *Cooling Capacity.* The capacity associated with the change in air enthalpy which includes both the Latent and Sensible Capacities expressed in W [Btu/h].

3.1.1.1 *Latent Capacity.* Capacity associated with a change in humidity ratio.

3.1.1.2 *Sensible Capacity.* Capacity associated with a change in dry-bulb temperature.

3.1.2 *Heating Capacity.* The capacity associated with the change in dry-bulb temperature expressed in W [Btu/h].

3.2 *Fan.* A device for moving air which utilizes a power-driven rotating impeller.

3.3 *Forced-Air Circulation.* Air circulation caused by a difference in pressure produced by a fan.

3.4 *Grille.* Lattice or grating covering the delivery or intake opening of an air passage.

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- 3.5** *Non-Volatile Refrigerant Coil.* A coil in which the cooling fluid (usually water) remains in the liquid state during its passage through the coil.
- 3.6** *Published Rating.* A statement of the assigned values of those performance characteristics, under stated Rating Conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. The term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.
- 3.6.1** *Application Rating.* A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).
- 3.6.2** *Standard Rating.* A rating based on tests performed at Standard Rating Conditions.
- 3.7** *Rating Conditions.* Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.
- 3.7.1** *Standard Rating Conditions.* Rating Conditions used as the basis of comparison for performance characteristics.
- 3.8** *Room Fan-Coil (cooling, heating, or cooling and heating).* A factory-made assembly which provides the functions of cooling, heating, or cooling and heating, but which does not include the source of cooling or heating. This device is designed for free-delivery of air into a room, but may be applied with minimal duct work having a static resistance generally not exceeding 0.062 kPa [0.25 in H₂O]. These devices may be designed for furred-in application, or with an enclosure for application within the conditioned space.
- 3.9** *Room Fan-Coil Motors.*
- 3.9.1** *Shaded Pole Motor.* Single phase AC motor with offset start winding and no capacitor.
- 3.9.2** *PSC Motor.* Single phase AC motor with offset start winding with capacitor.
- 3.9.3** *EC Motor.* AC electrically commutated permanent magnet DC motor.
- 3.10** *"Shall" or "Should,"* "Shall" or "should" shall be interpreted as follows:
- 3.10.1** *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.
- 3.10.2** *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.
- 3.11** *Standard Air.* Air weighing 1.2 kg/m³ [0.075 lb/ft³] which approximates dry air at 70°F [21°C] and at a barometric pressure of 101.3 kPa [29.92 in Hg].
- 3.12** *Volatile Refrigerant Coil.* A coil in which the cooling fluid evaporates during its passage through the coil.

Section 4. Classifications

4.1 *Methods of Classification.* Room Fan-Coils shall be classified according to the following:

4.1.1 By mounting arrangement (exposed or recessed; floor, wall or ceiling mounted)

1. Vertical
2. Horizontal

4.1.2 By water temperature rise

1. Normal rise
2. High rise

Section 5. Test Requirements

5.1 *Test Requirements.* All published ratings shall be verified by tests conducted in accordance with the provisions set forth in ASHRAE Standard 79 and 5.1.1 through 5.1.3.

5.1.1 *Free Delivery Units.* Units furnished with filters and grilles shall be tested with an external static pressure of **0.0 kPa [0.0 in H₂O]**.

5.1.2 *Furred-in Units.* Furred-in fan-coils 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 **0.01kPa [0.05 in H₂O]**.

5.1.3 *High Static Units.* The standard rating test shall be conducted with an external static pressure of **0.050 kPa [0.20 in H₂O]**.

Section 6. Rating Requirements

6.1 *Published Ratings.* Published Ratings of Room Fan-Coils shall include the information specified in 7.2 and shall include or be accompanied by the Standard Rating, properly identified as such. Application ratings shall clearly define the pertinent conditions.

6.2 *Standard Ratings.* Standard Ratings shall be established at the Standard Rating Conditions specified in 6.3. All Standard ratings shall be verified by tests conducted in accordance with Section 5. In these ratings, capacity shall be expressed in terms of W [Btu/h] (in multiples of 30 W [100 Btu/h]), airflow rate shall be expressed in terms of **m³/s [cfm]** (in multiples of **0.0047 m³/s [10 cfm]**), power input shall be expressed in W [W] (in multiples of 1W [1 W]), and water pressure drop shall be expressed in ft **kPa [H₂O]** (in multiples of **0.3 kPa [0.1 ft H₂O]**).

6.3 *Standard Rating Conditions.* Standard Ratings shall be determined by tests, using the methods of testing set forth in Section 5 and performed under the following:

6.3.1 *Cooling Rating Conditions.*

- a. Inlet temperatures of air to be conditioned: **80.0°F [26.7°C]** dry-bulb, **67.0°F [19.4°C]** wet-bulb
- b. Inlet water temperature (all units): **7.2°C [45°F]**
- c. Outlet water temperature: **55.0°F [12.8°C]** for normal temperature rise units and **60.0°F [15.6°C]** for high temperature rise units
- d. Water flow rate determined using the Standard Rating water temperature conditions specified above in **L/s [gpm]**
- e. Zero static pressure difference between air inlet and outlet of the Room Fan-Coil (except for equipment covered in 5.1.2 and 5.1.3)
- f. Highest fan-speed setting
- g. Outside air dampers closed

6.3.2 *Heating Rating Conditions.* Standard ratings shall be determined by tests, using the methods of testing set forth in Section 5 and performed in accordance with Table 1 and the following Standard Rating Conditions:

- a. Highest fan-speed setting
- b. Outside air dampers closed

Table 1. Heating Rating Conditions		
	Coil for Heating & Cooling	Coil for Heating Only
Entering Air Temperature dry-bulb, °F [°C]	70.0 [21.1]	70.0 [21.1]
Entering Air Temperature wet-bulb, °F [°C]	60.0 [15.6] MAX	60.0 [15.6] MAX
Entering Water Temperature, °F [°C]	140 [60.0]	180 [82.2], 140 [†60.]
Water flow rate, L/s [gpm]	Flow from Cooling Rating Test	†
Air Flow Rate, m ³ /s [cfm]	Zero static pressure difference between inlet and outlet of the Room Fan-Coil except for cooling equipment covered in 5.1.2 and 5.1.3	Zero static pressure difference between inlet and outlet of the Room Fan-Coil at the static pressure specified under 5.1.2 and 5.1.3
Water Temperature Difference, °F [°C]	‡	40.0 [22.2]
* Optional		
† Flow rate at 22.2°C [40.0°F] water temperature difference (rating not required)		
‡ Water temperature difference at rated flow (rating not required)		

6.3.3 Electrical Conditions. Standard rating tests shall be performed at the nameplate rated voltage(s) and frequency.

For units with dual nameplate voltage ratings, standard rating tests shall be performed at both voltages, or at the lower of the two voltages, if only a single Standard Rating is to be published.

6.3.4 Airflow and Electric Power Input Rating Conditions. Standard airflow and electric power input ratings shall be determined by tests using the methods of testing set forth in Section 5 and performed under the following Standard Rating Conditions:

- a. Inlet air dry-bulb temperature: 26.7°C [80.0°F]
- b. No water flow through coil
- c. Zero static pressure difference between air inlet and outlet of Room Fan-Coils (except for equipment covered in 5.1.2 and 5.1.3)
- d. High fan-speed setting

6.4 Application Rating Conditions. Application ratings should permit selection of units for at least a range of conditions commonly encountered, and should be based on corresponding ranges of the following selection parameters:

- a. Air inlet dry-bulb temperature, °F [°C]
- b. Air inlet wet-bulb temperature, °F [°C] (cooling only)
- c. Water inlet temperature, °F [°C]
- d. Water temperature rise or drop, °F [°C] or water flow rate, L/s [gpm]
- e. Fan motor speed control setting

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- 6.5** *Similar Models.* Where more than one model of a particular size of Room Fan-Coil is produced having identical blowers and coils, similar motor speeds, and identical arrangement of parts relative to each other, a representative sample may be tested by the manufacturer to obtain ratings for these units. Such a representative sample should be the standard model of this particular size having the lowest air delivery. Where there is a variation between models as to the coil configuration, blowers, motor speeds, or the relative arrangement of parts, separate tests are recommended for each such variation.
- 6.6** *Tolerances.* The Standard Rating shall be such that any Room Fan-Coil selected at random and tested in accordance with this standard, an air-quantity, total Cooling Capacity, Heating Capacity and sensible Cooling Capacity not less than 95 percent of the Standard Rating values, and an electrical power input not more than 110 percent of the standard rating value, and a water pressure drop not more than 110 percent of the Standard Rating value or Standard Rating Value + 3 kPa [1 ft H₂O], whichever is greater.

Section 7. Minimum Data Requirements for Published Ratings

- 7.1** *Minimum Data Requirements for Published Ratings.* As a minimum, Published Ratings shall include all Standard Ratings. All claims to ratings within the scope of this standard shall include the statement “Rated in accordance with ISHRAE/ARI Standard 440”. All claims to ratings outside the scope of this standard shall include the statement “Outside the scope of ISHRAE/ARI Standard 440”. Wherever application ratings are published or printed, they shall include or be accompanied by the Standard Rating clearly designated as such, including a statement of the conditions at which the ratings apply.
- 7.2** *Content of Published Ratings.* Published Ratings shall consist of the following information:
- a. Airflow under dry-coil conditions with inlet air dry-bulb temperature 80.0°F [26.7 °C], m³/s [cfm]
 - b. Electric power input, measured at 7.2a., W [W]
 - c. Capacity, W [Btu/h]
 1. Cooling
 - Total Cooling
 - Sensible
 2. Heating
 - d. Fluid Flow rate, L/s [gpm]
 - e. Fluid pressure drop through the coil, kPa [ft. H₂O]
- 7.3** *Published Rating Data.* Published Ratings shall include, or be accompanied by, the following data:
- a. Nameplate Electrical data
 1. Voltage, volts [V]
 2. Full-load current, amperes [A]
 - b. Minimum grille free areas, mm² [in²]
 1. Inlet
 2. Outlet
 - c. Filter data as supplied or recommended by manufacturer
 1. Type
 2. Size, in x in [mm x mm]
 3. Thickness, in [mm]
 - d. Drawings indicating essential dimensions, including the height and depth of the enclosure, sizes of inlet and outlet openings and grilles (if used), and size and location of piping and electrical connections

Section 8. Operating Requirements

8.1 *Insulation Efficiency Test.* Room Fan-Coils shall pass the following insulation efficiency test:

8.1.1 *Temperature Conditions.*

- a. Ambient air temperature: 80.0°F [26.7 °C] dry-bulb, 75.0°F [23.9 °C] wet-bulb
- b. Entering water temperature: 43°F [6.1°C]
- c. Water temperature rise: 6.0°F [3.3 °C]

8.1.2 *Procedure.* After establishing specified temperature conditions, the unit shall operate continuously at its lowest fan speed for a period of four hours at the following external static pressure:

- a. Free Delivery 0.0 kPa [0.0 in of H₂O]
- b. Furred-In 0.0 kPa [0.0 in of H₂O]
- c. High-Static 0.012 kPa [0.05 in of H₂O]

For equipment with a single fan speed the external static pressure specified in the standard cooling test shall be used.

8.1.3 *Requirements.* During the test, no condensed water shall drip, run, or blow off from the unit.

8.2 *Low Voltage Test.* Room Fan-Coils shall start and operate at 90 percent of nameplate rated voltage at all fan speed settings.

Section 9. Marking and Nameplate Data

9.1 *Nameplate Data.* As a minimum, the nameplate on Room Fan-Coils shall display the manufacturer's name, model designation, and electrical characteristics, **cfm, capacity.**

Section 10. Conformance Conditions

10.1 *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such product claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard shall not reference, state, or acknowledge the standard in any written, oral, or electronic communication.

APPENDIX A. REFERENCES - NORMATIVE

- A1** Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standard. All references in this appendix are considered as part of the standard.
- A1.1** ANSI/ARI Standard 430-1999, *Central Station Air-Handling Units*, 1999, American National Standards Institute/Air-Conditioning and Refrigeration Institute, 11 West 42nd Street, New York, NY 10036, U.S.A./ 4100 North Fairfax Drive, Suite 200, Arlington, VA 22203, U.S.A.
- A1.2** ASHRAE *Terminology of Heating, Ventilation, Air Conditioning and Refrigeration*, 1991, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.
- A1.3** ARI Standard 110-2002, *Air-Conditioning and Refrigerating Equipment Nameplate Voltages*, 2002, Air-Conditioning and Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, VA 22203, U.S.A.
- A1.4** ARI Standard 840-1998, *Unit Ventilators*, 1998, Air-Conditioning and Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, VA 22203, U.S.A.
- A1.5** ASHRAE Standard 79-2002, *Methods of Testing for Rating Room Fan-Coil Air-Conditioners*, 2002, American Society of Heating Refrigeration and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.
- A1.6** IEC Standard 60038, *IEC Standard Voltages*, 2002, International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, 1211 Geneva 20, Switzerland.

APPENDIX B. REFERENCES - INFORMATIVE

- B1** Listed here are standards, handbooks and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.
- B1.1** ARI Standard 260-2001, *Sound Rating of Ducted Air Moving and Conditioning Equipment*, 2001, Air-Conditioning and Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, VA 22203, U.S.A.
- B1.2** ARI Standard 350-2000, *Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment*, 2000, Air-Conditioning and Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, VA 22203, U.S.A.