

# ANSI/AHRI Standard 440 with Addendum 1 (Formerly ARI Standard 440)

## 2008 Standard for Performance Rating of Room Fan- Coils



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# ANSI/AHRI STANDARD 440 -2008 WITH ADDENDUM 1, *PERFORMANCE RATING OF ROOM FAN-COILS*

**April 2014**

Note: This addendum is not ANSI approved but will be submitted to ANSI for approval.

Addendum 1 (dated April 2014) of ANSI/AHRI Standard 440-2008 modifies ANSI/AHRI Standard 440-2008 as follows. The following changes have been incorporated (additions are shown by shading and deletions are shown by ~~strike throughs~~) into Insulation Efficiency Test in Sections 8.1.1 and 8.1.2 of the already published 2008 version of ANSI/AHRI Standard 440 -2008.

The changes include:

**8.1.1** ~~Temperature~~ **Test 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]~~ 42°F [5.6°C]
- c. ~~Water temperature rise: 6.0°F [3.3°C]~~ Water flow rate from standard cooling rating test

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

- a. Free Delivery 0.0 in H<sub>2</sub>O [0.0 kPa]
- b. Furred-in 0.0 in H<sub>2</sub>O [0.0 kPa]
- c. High-Static 0.050 in H<sub>2</sub>O [0.012 kPa]

For equipment with motor speed taps, the unit shall be set to the lowest fan-speed tap. For equipment without motor speed taps, the unit shall be run at a fan-speed which produces between 60% and 70% of the airflow at which the standard cooling rating test was conducted, with instructions provided by the manufacturer on how to adjust the motor controls to achieve this setting.

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

## **IMPORTANT**

### ***SAFETY DISCLAIMER***

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk .

## **AHRI 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 1500 cfm [0.7080 m<sup>3</sup>/s] or less.

Room Fan-Coils employing Volatile Refrigerant Coils or steam coils, central-station air-handling units as defined in AHRI Standard 430, and unit ventilators as defined in 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 (Section 6.3.1), and for power input (Section 6.3.4):

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

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

Note:

This standard supersedes ARI Standard 440-2005.

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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 1500 cfm [0.7080 m<sup>3</sup>/s] or less.

**2.2** *Exclusions.*

**2.2.1** This standard does not apply to central-station air-handling units as defined in ANSI/AHRI Standard 430.

**2.2.2.** This standard does not apply to unit ventilator units as defined in AHRI 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

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 Btu/h[W].

**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 Btu/h[W].

**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.

**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 0.25 in H<sub>2</sub>O [0.062 kPa]. These devices may be designed for furred-in application, or with an enclosure for application within the conditioned space.

**3.8.1** *Free Delivery Units.* Free Delivery Units are Room Fan-Coils furnished with both integral filters and grilles on the unit.

**3.8.2** *Furred-in Units.* Furred-in Units are Room Fan-Coils intended to be installed above a ceiling, within a side wall, or with a discharge grille. It may or may not have provisions for a filter.

**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 0.075 lb/ft<sup>3</sup> [1.2 kg/m<sup>3</sup>] which approximates dry air at 70°F [21°C] and at a barometric pressure of 29.92 in Hg [101.3 kPa].

**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.* Free Delivery Units furnished with filters and grilles shall be tested with an external static pressure of 0.0 in. H<sub>2</sub>O [0.0 kPa].

**5.1.2** *Furred-in Units.* Furred-in fan-coils shall be tested at an external static pressure of 0.05 in H<sub>2</sub>O [ 0.01 kPa], and without filters and grilles.

**5.1.3** *High Static Units.* The standard rating test shall be conducted with an external static pressure of 0.20 in H<sub>2</sub>O [0.050 kPa].

## 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 Btu/h [W] (in multiples of 100 Btu/h [30 W]), airflow rate shall be expressed in terms of cfm [m<sup>3</sup>/s] (in multiples of 10 cfm [0.0047 m<sup>3</sup>/s]), power input shall be expressed in W [W] (in multiples of 1 W [1 W]), and water pressure drop shall be expressed in ft H<sub>2</sub>O [kPa] (in multiples of 0.1 ft H<sub>2</sub>O [0.3 kPa]).

**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. Entering temperatures of air to be conditioned: 80.0°F [26.7°C] dry-bulb, 67.0°F [19.4°C] wet-bulb
- b. Entering water temperature (all units): 45°F [7.2°C]
- c. Leaving 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, gpm [L/s]
- e. 0 in H<sub>2</sub>O [0 Pa] 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

<b>Table 1. Heating Rating Conditions</b>		
	Coil for Heating & Cooling	Coil for Heating Only
Entering Air Dry-bulb Temperature, °F [°C]	70.0 [21.1]	70.0 [21.1]
Entering Air Wet-bulb Temperature, °F [°C]	60.0 [15.6] Max	60.0 [15.6] Max
Entering Water Temperature, °F [°C]	140 [60.0]	180 [82.2], 140* [60.0*]
Water Flow Rate, gpm [L/s]	Flow rate from cooling rating test	†
Airflow Rate, cfm [m <sup>3</sup> /s]	0 in H <sub>2</sub> O [0 Pa] 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	0 in H <sub>2</sub> O [0 Pa] 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 40.0°F [22.2°C] 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. Entering air dry-bulb temperature: 80.0°F [26.7°C]
- b. No water flow through coil
- c. 0 in H<sub>2</sub>O [0 Pa] 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 shall permit selection of units for at least a range of conditions commonly encountered, and shall be based on corresponding ranges of the following selection parameters:

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



**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 shall be tested by the manufacturer to obtain ratings for these units. Such a representative sample shall be the standard model of this particular size having the lowest air delivery.

**6.6** *Tolerances.* The Standard Rating shall be such that any Room Fan-Coil selected at random and tested in accordance with this standard has an airflow rate, total Cooling Capacity, Heating Capacity and sensible Cooling Capacity not less than 95 percent of the Standard Ratings, an electrical power input not more than 110 percent of the Standard Ratings, and a water pressure drop not more than 110 percent of the Standard Rating or Standard Rating + 1 ft H<sub>2</sub>O [3 kPa], 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 AHRI Standard 440”. All claims to ratings outside the scope of this standard shall include the statement “Outside the scope of AHRI 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 rate at dry-coil conditions with an entering air dry-bulb temperature of 80.0°F [26.7°C], cfm [m<sup>3</sup>/s]
- b. Electric power input, (measured at conditions in 7.2a), W [W]
- c. Capacity, Btu/h [W]
  1. Cooling
    - Total Cooling
    - Sensible
  2. Heating
- d. Fluid Flow rate, gpm [L/s]
- e. Fluid pressure drop through the coil, ft H<sub>2</sub>O [kPa]

**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, in<sup>2</sup> [mm<sup>2</sup>]
  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 Test 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] 42°F [5.6°C]
- c. ~~Water temperature rise: 6.0°F [3.3°C]~~ Water flow rate from standard cooling rating test

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

- a. Free Delivery 0.0 in H<sub>2</sub>O [0.0 kPa]
- b. Furred-in 0.0 in H<sub>2</sub>O [0.0 kPa]
- c. High-Static 0.050 in H<sub>2</sub>O [0.012 kPa]

For equipment with motor speed taps, the unit shall be set to the lowest fan-speed tap. For equipment without motor speed taps, the unit shall be run at a fan-speed which produces between 60% and 70% of the airflow at which the standard cooling rating test was conducted, with instructions provided by the manufacturer on how to adjust the motor controls to achieve this setting.

For equipment with a single fan speed, the external static pressure specified in the standard cooling rating 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.

**9.2** *Nameplate Voltages.* Nameplate voltages for 60 Hertz systems shall include one or more of the utilization voltages shown in Table 1 of ARI Standard 110. Nameplate voltages for 50 Hertz systems shall include one or more of the utilization voltages shown in Table 1 of IEC Standard 60038.

### 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** AHRI Standard 110-2002 (formerly ARI Standard 110-2002), *Air-Conditioning and Refrigerating Equipment Nameplate Voltages*, 2002, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.

**A1.2** AHRI Standard 840-1998 (formerly ARI Standard 840-1998), *Unit Ventilators*, 1998, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.

**A1.3** ANSI/AHRI Standard 430-1999 (formerly ANSI/ARI Standard 430-1999), *Central Station Air-Handling Units*, 1999, American National Standards Institute/Air-Conditioning, Heating, and Refrigeration Institute, 11 West 42nd Street, New York, NY 10036, U.S.A./ 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.

**A1.4** ASHRAE Standard 79-2002 (RA 2006), *Methods of Testing for Rating Room Fan-Coil Air-Conditioners*, 1991, American Society of Heating Refrigeration and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

**A1.5** 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.

**A1.6** 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 as part of the standard.

**B1.1** AHRI Standard 260-2001 (formerly ARI Standard 260-2001), *Sound Rating of Ducted Air Moving and Conditioning Equipment*, 2001, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.

**B1.2** AHRI Standard 350-2000 (formerly ARI Standard 350-2000), *Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment*, 2000, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22201, U.S.A.