AHRI Standard 441 (SI)

2019 Standard for

Performance Rating of Fan-coil Units

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IMPORTANT

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Note:

This is a new standard.

For I-P ratings, see AHRI Standard 440 (I-P)-2019.

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PERFORMANCE RATING OF FAN-COIL UNITS

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to provide for Fan-coil Units: definitions; 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 Fan-coil Units as defined in Section 3.16.

2.2 *Exclusions*.

2.2.1 This standard does not apply to Central-station Air-handling Units as defined in 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 Fan-coil Units employing:

2.2.3.1 Volatile Refrigerant Coils.
2.2.3.2 Only Steam Coils.

2.2.4 This standard does not apply to Fan-powered Chilled Water Terminals.

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the *ASHRAE Terminology* website (https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology) and ANSI/ASHRAE Standard 79 unless otherwise defined in this Section.

3.1 *Air Temperature, Coil Entering (EAT_C).* The temperature of the air immediately prior to entering the Coil.

3.2 *Air Temperature, Coil Leaving (LAT_C).* The temperature of the air as it exits the Fan-coil Unit.

3.3 *Air Temperature, Unit Entering (EAT_U).* The temperature of the air immediately prior to entering the Fan-coil Unit.
3.4 *Air Temperature, Unit Leaving (LAT_U).* The temperature of the air immediately as it exits the Fan-coil Unit.

3.5 *Airflow, Actual Entering ($ACMH_E$).* The volumetric flowrate of air entering Fan-coil Unit.

3.6 *Airflow, Actual Leaving ($ACMH_L$).* The volumetric flowrate of air leaving the Fan-coil Unit.

3.7 *Airflow, Standard (SCMH).* The volumetric flowrate of air moving through the Coil after being corrected from $ACMH_E$ or $ACMH_L$.

3.8 *Appurtenances.* Components in the Fan-coil Unit, other than Coils, located in the air path that have an effect on static pressure drop or create system effect. These include, but are not limited to, filters, Grilles, and diffusers.

3.9 *Base Unit.* A given configuration of a unit model, size, motor type and Fan type with the least resistance to airflow created by Coils and Appurtenances.

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3.10 *Blow-through*. A unit configuration where the fan(s) is (are) located in the airstream before the Coil such that Fan Heat must be added to the Unit Entering Air Temperature to determine the Coil Entering Air Temperature.

3.11 *Capacity*.

3.11.1 *Capacity, Unit Total (Q_{UT}).* The capacity associated with the change in air enthalpy across the Fan-coil Unit which includes both the latent and sensible Capacities expressed in W.

3.11.1.1 *Capacity, Unit Latent (Q_{UL}).* The capacity associated with a change in humidity ratio across the Fan-coil Unit expressed in W.

3.11.1.2 *Capacity, Unit Sensible (Q_{US}).* The capacity associated with a change in dry-bulb temperature across the Fan-coil Unit expressed in W.

3.11.2 *Capacity, Coil Total (Q_{CT}).* The capacity associated with the change in air enthalpy across the Coil only, calculated using the method in AHRI Standard 410, which includes both the Latent and Sensible Capacities expressed in W.

3.11.2.1 *Capacity, Coil Latent (Q_{CL})* . The capacity associated with a change in humidity ratio across the Coil only expressed in W.

3.11.2.2 *Capacity, Coil Sensible (Q_{CS}).* The capacity associated with a change in dry-bulb temperature across the Fan-Coil Unit expressed in W.

3.12 *Coil.* A heat exchanger, with or without extended surfaces, through which a single-phase fluid flows for the purpose of heat transfer in the Fan-coil Unit. A Coil may be a Cooling Coil, Heating Coil or serve both functions.

3.12.1 *Cooling Coil.* A Coil that is used for reducing the temperature and/or the humidity of the circulating air.
3.12.2 *Heating Coil*. A Coil that is used for increasing temperature of the circulating air.

3.13 *Draw-through*. A unit configuration where the fan(s) is located in the airstream after the Coil such that Fan Heat shall be added to the Coil Leaving Air Temperature to determine the Unit Leaving Air Temperature.

3.14 *Ducted Unit.* A Fan-coil Unit that has provisions for an air passage (duct) to supply Airflow to or from a space. The duct could be on the supply, return, or both.

3.15 *Fan*. A device for moving air which utilizes a motor-driven impeller.

3.16 *Fan-coil Unit.* A factory-made assembly that provides Forced-air Circulation, cooling or cooling and heating, and filtering of air, with a maximum design External Static Pressure (ESP) less than or equal to 0.25 kPa, that does not include the source of cooling or heating, with the exception of optional electric heat.

3.17 *Fan-powered Chilled Water Terminal (FPCWT).* Devices which include a hydronic Cooling Coil and an airflow regulating primary air valve and in which the primary air valve is in series with the Fan and all air flows through the Fan. The primary air shall bypass the Cooling Coil. The Cooling Coil shall be designed and rated for sensible operation only. The unit may have supplemental heat. The unit shall be designed to be ceiling or floor-plenum mounted and designed for ducted primary air and discharge air.

3.18 *Fan-coil Unit Motors.*

3.18.1 *EC Motor (ECM).* An electronically commutated permanent magnet motor.
3.18.2 *PSC Motor*. Single phase AC motor with offset start winding with capacitor.
3.18.3 *Shaded Pole Motor*. Single phase AC motor with offset start winding and no capacitor.

3.19 *Fan Heat (P_e).* The enthalpy added to the airstream by the Fan and motor. For this standard, the entire electrical power input to the motor is considered to be the Fan Heat.

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3.20 *Fan Setting.* The selected control point for the Fan.

3.21 *Forced-air Circulation*. Air circulation caused by a difference in pressure produced by a Fan.

3.22 *Free Delivery Units.* Fan-coil Units intended to be installed in the conditioned space and have no duct attached to distribute conditioned air. The units operate at an External Static Pressure of 0 kPa and may be furnished with both integral filters and Grilles on the unit. Free Delivery Units is equal to Non-ducted.

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

3.24 *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.

3.24.1 *Application Rating*. A rating based on tests performed at conditions outside the range of Standard Rating Conditions.

3.24.2 *Standard Rating*. Ratings within the range of Standard Rating Conditions and which are accurate representations of test data.

3.25 *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.

3.25.1 *Standard Rating Conditions*. Rating Conditions used as the basis of comparison for performance characteristics.

3.26 *"Shall" or "Should,"* "Shall" or "Should" shall be interpreted as follows:

3.26.1 *Shall*. Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.26.2 *Should*. "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.27 *Standard Air*. Air weighing 1.20 kg/m^3 which approximates dry air at 21 °C and at a barometric pressure of 101.3 kPa.

3.28 *Static Pressure, Additional (SP_{ADD}).* The static pressure increase required to move air through the Fan-coil Unit at a given Airflow when the unit is configured with Coil(s) and/or Appurtenances that create a larger pressure drop than the Base Unit.

3.29 *Static Pressure, External (ESP).* The static pressure required to overcome duct resistance. This value is supplied by the user. For Free Delivery Units, this value is zero.

3.30 *Steam Coil*. A Heating Coil using steam as the tubeside fluid.

3.31 *Volatile Refrigerant Coil*. A Coil in which the cooling fluid evaporates during its passage through the Coil.

Section 4. Test Requirements

4.1 *Test Requirements*. All published ratings shall be verified by tests conducted in accordance with the provisions set forth in ANSI/ASHRAE Standard 79, except as modified below.

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4.1.1 *Outside Air Dampers*. All testing described in this section shall be conducted with all outside air dampers closed.

4.1.2 *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 rating is to be Published.

4.2 *Hydronic and Steam Coils.* For each fin type, the appropriate Coils shall be tested per the requirements of AHRI Standard 410 to allow rating of the coil thermal performance over the range of airflows, entering air temperatures, fluid types, fluid flows, and fluid entering temperatures that are offered by the manufacturer.

4.3 *Airflow and Power Consumption.* Each Base Unit shall be tested over the range of ESP described below. Airflow testing shall be per ANSI/ASHRAE Standard 79. The Fan-coil Unit(s) Airflow shall be tested without water flow. If different motor types are available, then each motor type shall be tested. If different voltages are offered, then each voltage shall also be tested, unless it can be shown that the airflow and power consumption does not differ by more than 3% between the voltages. At least four (4) points will be measured for each Fan Setting. The manufacturer shall collect enough data to predict the airflow and power consumption for anyFan Settings and any configuration of the unit,.

4.3.1 *PSC or Shaded Pole Motors with Discrete Taps*. Each unit shall be tested at each discrete tap from 0.0 kPa ESP up to the highest ESP plus SP_{ADD} at which the Fan-coil Unit will be rated.

4.3.2 *EC Motors speed (RPM) or Torque Controlled.* Each unit shall be tested at its maximum, minimum and an intermediate speed or torque. The difference between the intermediate speed tested and the mean of the maximum and minimum speeds shall be less than 15%. Each speed shall be tested from 0.0 kPa ESP up to the highest ESP plus SP_{ADD} at which the user will be allowed to rate the Fan-coil Unit.

4.3.3 *EC Motors Airflow Controlled.* Each unit shall be tested at its maximum, minimum and an intermediate airflow. The difference between the intermediate airflow tested and the mean of the maximum and minimum speeds shall be less than 15%. Each airflow shall be tested from 0.0 kPa ESP up to the highest ESP plus SP_{ADD} at which the user will be allowed to rate the Fan-coil Unit.

4.4 *Capacity.* Fan-coil Units shall be tested for Capacity per the method defined in ANSI/ASHRAE Standard 79 to determine their measured Capacity compared to predicted Capacity calculated from the coil program with fan heat correction. At a minimum at least one unit of each size from given Fan-coil Unit line will be tested. The Base Unit shall be tested at each condition of Table 1:

Table 1. Test Conditions for Mapping Fan-coil Cooling Performance

Fan Settings	Entering Dry-bulb Temperature, °C	Entering Wet-bulb Temperature, °C	Entering Water Temperature, °C	Leaving Water Temperature[1], °C
High	26.5	19.5	7	12.5 or 15.5
High	24	17	7	12.5 or 15.5
High	22	14	9	14.5 or 17.5
Medium[2]	26.5	19.5	7	12.5 or 15.5
Medium[2]	24	17	7	12.5 or 15.5
Medium[2]	22	14.5	9	14.5 or 17.5

Notes:
1. Approximate leaving water temperature. Manufacturer shall use 5.5 or 8.5 °C delta T.
2. Medium is defined in Section 4.3.

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