

2008 STANDARD FOR

Standard 430

Central Station Air-Handling Units



ISHRAE

(INDIAN SOCIETY OF HEATING,
REFRIGERATING & AIR
CONDITIONING ENGINEERS

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IMPORTANT

SAFETY RECOMMENDATIONS

It is strongly recommended that the product be designed, constructed, assembled and installed in accordance with nationally recognized safety requirements appropriate for products covered by this standard.

ARI-ISHRAE as an independent national body uses its best efforts to develop standards employing state-of-the-art and accepted industry practices. However, ARI-ISHRAE does not certify or guarantee safety of any products, components or systems designed, tested, rated, installed or operated in accordance with these standards or that any tests conducted under its standards will be non-hazardous or free from risk.

ARI-ISHRAE CERTIFICATION PROGRAM PROVISIONS

Scope of the Certification Program

The Certification Program includes all sizes of central station air-handling units as defined in Section 2.

Certified Ratings

The following Certification Program ratings are verified by test:

1. Fan Speed, rev/s [rpm]
2. Brake Horsepower, W [bhp]

Note:

This standard supersedes ARI Standard 430 – 99.

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CENTRAL STATION AIR-HANDLING UNITS

Section 1. Purpose

- 1.1 Purpose.** The purpose of this standard is to establish for central station air-handling units: definitions; classifications; requirements for testing and rating; minimum data requirements for published ratings; 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 central station air-handling units, as defined in Section 3.
- 2.2 Exclusions.**
- 2.2.1** This standard does not apply to forced-circulation, free-delivery air-coolers for refrigeration, which are covered in [ARI-ISHRAE Standard 420](#).
- 2.2.2** This standard does not apply to unit heaters intended for free delivery of heated air or to room fan-coil air-conditioners as defined in [ARI-ISHRAE Standard 420](#).
- 2.2.3** This standard does not apply to units having direct expansion coils which are incorporated by the manufacturer in a matched split system air-conditioner or as otherwise defined in the product scope definition of the [ARI-ISHRAE Unitary Small Equipment and Unitary Large Equipment Sections](#) and covered in [ARI-ISHRAE Standard 210/240](#) or in [ARI-ISHRAE Standard 340/360](#).
- 2.2.4** This standard does not apply to unit ventilators as defined in [ARI-ISHRAE Standard 840](#).
- 2.2.5** This standard does not apply to ratings for plenum (plug) and axial fans.

Section 3 Definitions

- 3.1 Definitions.** All terms in this document will 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.

- 3.2 Central Station Air-Handling Unit.** A factory-made encased assembly consisting of a fan or fans and other necessary equipment to perform one or more of the functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying and mixing of air; and shall not contain a source of cooling or heating other than gas or electric heat. This device is capable of use with duct work having a total static resistance of at least **0.12 kPa [0.5 in. H₂O]**.
- 3.2.1 Blow-Through Central Station Air-Handling Unit** (see Figure 1). A unit containing a fan that does not have a ducted fan outlet.
- 3.2.2 Draw-Through Central Station Air-Handling Unit** (see Figure 2). A unit that has a ducted fan outlet.
- 3.2.3 Fan.** An impeller and any other items, such as housings and inlet vanes that are an integral part of the impeller and/or housing that affect the basic performance characteristics of the fan.
- 3.2.4 Unit Appurtenances.** Equipment added for purposes of control, isolation, safety, static pressure regain, wear, etc. Such appurtenances include coils, filters, dampers, air-mixers, sprays, eliminators, etc.
- 3.3 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. As used herein, 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.
- 3.3.1 Standard Rating.** A rating based on tests performed at Standard Rating Conditions.
- 3.3.2 Application Rating.** A rating based on tests performed at Application Rating Conditions (other than Standard Rating Conditions).
- 3.4 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.
- 3.4.1 Standard Rating Conditions.** Rating conditions used as the basis of comparison for performance characteristics.

3.5 "Shall," "Should," "Recommended" or "It Is Recommended." "Shall," "should," "recommended" or "it is recommended" shall be interpreted as follows:

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

3.5.2 *Should, Recommended or It is Recommended.* "Should," "recommended" or "it is recommended" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.6 *Standard Air.* Air weighing 1.2 kg/m^3 [0.075 lb/ft^3] which approximates dry air at 21.1°C [70.0°F] and at a barometric pressure of 101.1 kPa [29.92 in. Hg]

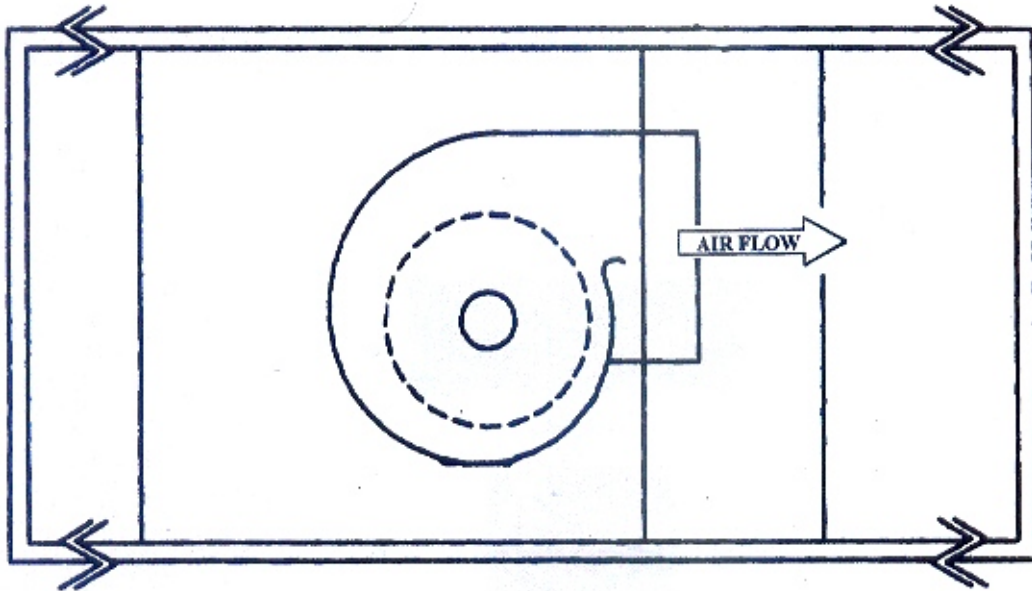


Figure 1. Blow-Through Central Station Air-Handling Unit

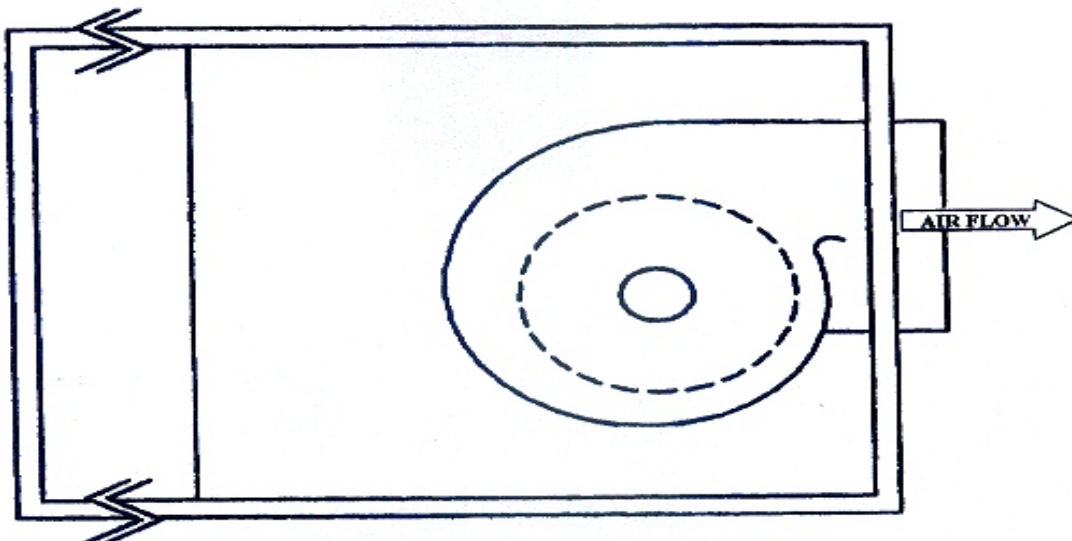


Figure 2. Draw-Through Central Station Air-Handling Unit

Section 4. Classifications

4.1 *Methods of Classification.* Central station air-handling units may be classified according to the following:

A. Unit Type

1. Blow-through
2. Draw-through

B. Application Type

1. Indoor
2. Outdoor

Section 5. Test Requirements

5.1 *Testing Requirements.* All standard Ratings shall be verified by tests conducted in accordance with ANSI/ASHRAE Standard 51/AMCA Standard 210, except as modified by 5.1.1.3.

5.1.1 *Arrangements for Testing.*

5.1.1.1 *Single Outlet Draw-Through Units.* Single outlet draw-through units shall be tested in accordance with ANSI/ASHRAE Standard 51/AMCA Standard 210.

5.1.1.2 *Multiple Outlet Draw-Through Units.* Multiple outlet draw-through units shall be tested as described above with each fan outlet ducted as shown in Figure 3 to the air flow measuring device. Individual fan outlet duct friction losses shall not be included.

5.1.1.3 *Blow-Through Units.* Blow-through units shall be tested in accordance with ANSI/ASHRAE Standard 51/AMCA Standard 210, except when an outlet chamber with multiple nozzles within the chamber is used. The test chamber cross-sectional area may be sized so that the maximum air velocity shall not exceed **400 fpm [2 m/s]**. The test chamber height and width shall be at least 5% greater than the respective height and width of the duct connection at the test chamber. Duct area at the test chamber connection plane cannot exceed the duct area at the unit connection plane.

5.2 *Description of Test Unit.* This standard permits the omission of all appurtenances in the test unit except the coil section, where used. Units to be tested shall contain the largest cataloged face area coil for that size and arrangement (where applicable). The coil, fan sheave, and largest internally mounted fan motor shall be mounted in their most restrictive cataloged location relative to the fan with the coil having a pressure drop of at least **0.019 kPa [0.075 in. H₂O]** at **2.54 m/s [500 fpm]** coil face velocity with Standard Air. The coil shall be de-energized and the unit operating without coil by-pass. In the case of a blow-through heating-cooling unit with multiple discharge path, all but the cooling coil position shall be blocked and the unit tested with horizontal air discharge. The pressure drop of the coils shall have been determined in accordance with ARI-ISHRAE Standard 410.

5.3 *Extension of Test Data.* Test data may be extended to other units in accordance with the provisions of 5.3.1, 5.3.2 and 5.3.3.

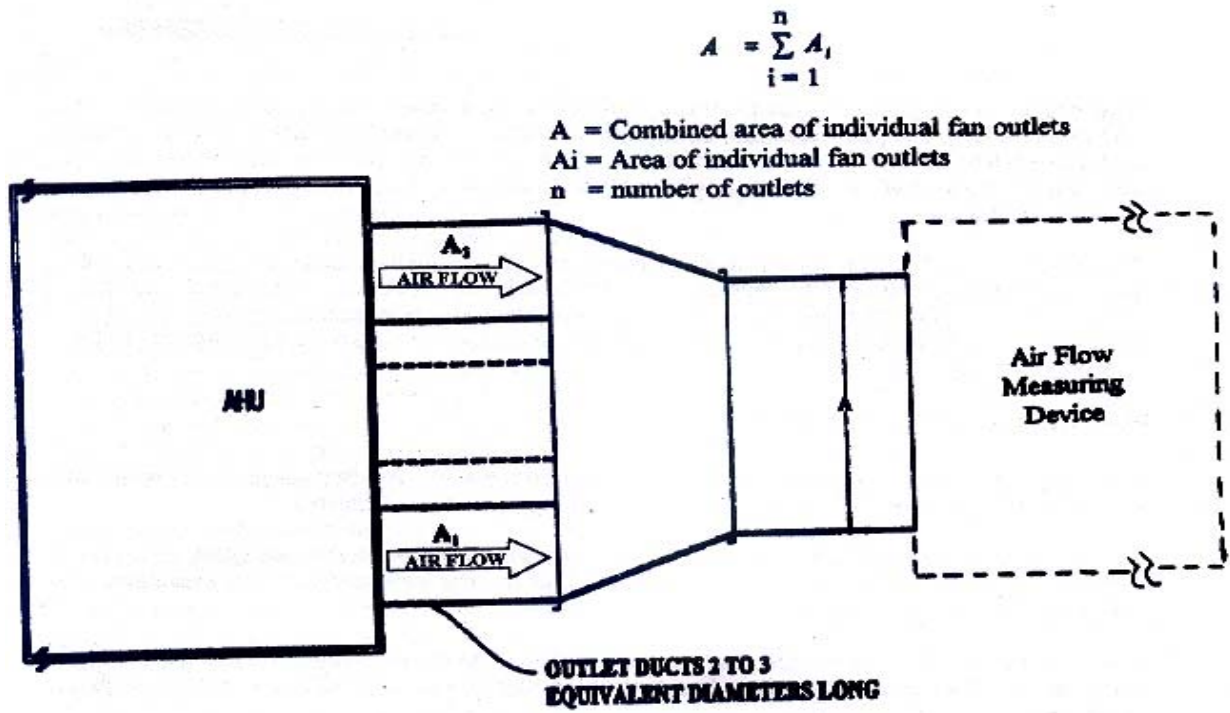


Figure 3. Multiple Fan Outlet Test Configuration

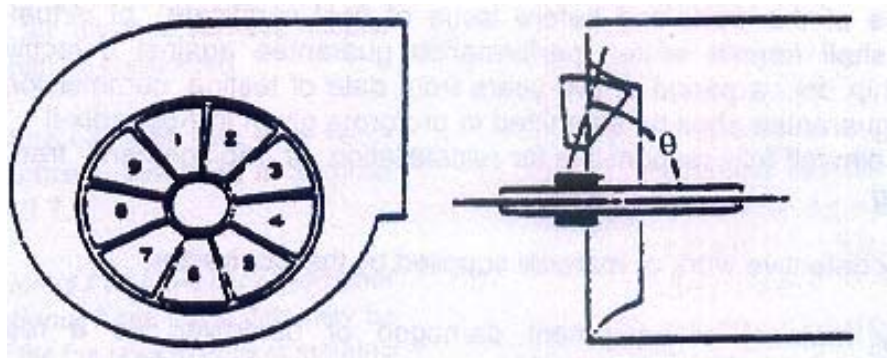


Figure 4. Dimensions for Inlet Vane Proportionality

5.3.1 Application of Fan Laws to Units with Inlet Vanes. Units with inlet vanes may be rated one of three ways: 1) using the fan laws as described by 5.3.2 for proportional units with proportional fans and inlet vanes; 2) using the fan laws as described in 5.3.3 for proportional units with non proportional fans and inlet vanes; or 3) using the fan laws by applying the appropriate inlet vane derate factors to units without inlet vanes rated per Sections 5.3.2 or 5.3.3 when the inlet vanes of the test unit are proportional to the inlet vanes of the rated units. (Since all requirements for proportionality of cabinets, fan impellers, and housing are satisfied by provisions in either 5.3.2 or 5.3.3 without inlet vanes, rated units with inlet vanes derived by inlet vane derate factors must only meet inlet vane proportionality criteria.)

Inlet vanes are considered to be proportional when the inlet vanes shall result in net air flow areas not less than 92.5% of those derived from exact proportionality (as defined in Section 5.3.2) when located within 0.5 impeller diameter from the fan inlet. The test unit must be tested with vanes in the wide open position as specified by the manufacturer. Vane shaft angle, θ , (with respect to fan shaft centerline) and the number of vane blades for the rated unit must be the same as for the test unit (see Figure 4). When evaluating geometrical proportionality of inlet vanes, the distance between vane and impeller (defined as dimensions between impeller inlet plane and the closest point of vanes with the vanes at wide open position, as set by the manufacturer) and the distance between cabinet side and fan inlet shall be considered.

The method of rating one unit with inlet vanes from the test of another is described in Sections 5.3.3.1 through 5.3.3.7.

5.3.2 Application of Fan Laws to Proportional Units with Proportional Fans. Test data may be extended by use of the fan laws to units containing fans, geometrically proportional fan cabinets and impellers (see Appendix C). The fan impeller diameter of the unit to be calculated shall not be less than 65% of the fan impeller diameter of the test unit.

Fans are considered to be proportional when:

- a. Impeller width, housing development radii, and housing width are proportional within $\pm 1.5\%$.
- b. Fan housing outlet area is proportional within $\pm 3\%$.

Fan cabinets are considered to be proportional when:

- a. The clearance between the unit casing and the nearest fan housing are proportional or greater.
- b. The clearance between adjacent fan housings, as measured parallel to the fan shaft, are proportional or greater.
- c. The fan cabinet unit casing inlet and the fan cabinet outlet air flow cross sectional areas are not less than 92.5% of the respective geometrically proportionate values.
- d. Arrangement and location of internal bearings and their supports, inlet vanes, motors and drives, shall result in net air flow areas not less than 92.5% of those derived from exact proportionality when located within 0.5 impeller diameter of the fan inlet.

The basis for proportionality in every case shall be the respective impeller diameters; linear dimensions shall be proportional to the diameter, and areas shall be proportional to the square of the diameter.

Single fan units may be rated from the test of a multiple fan unit provided that the units are otherwise proportional and that the clearance between fans on the multiple fan unit is not more than twice the proportionate clearance between the cabinet and the fan housing on a single fan unit. In no case, shall the ratings of a multiple fan unit from tests of a single fan unit be accepted. Air flow and fan shaft power are considered to be proportional to the number of fans.

Draw-through units which have a change in air-flow direction between the coil and the fan (Figure 5) may be rated from tests of units which do not have this flow direction change (Figure 2) provided the plenum causing the air direction change be considered an appurtenance and the effect of its application added to those of other appurtenances as provided in 6.1.1 There is no distinction in rating between a vertical discharge and a horizontal discharge blow-through unit.

The effects of proportions of bolts, nuts, rivets, etc., shall be considered to be negligible.

- 5.3.3.5** Adjust the curves in Figure 7 by the performance corrections between pairs of curves as indicated in Figure 6. The resultant curves are the calculated performance ratings for the unit not tested, expressed in percentages of performance of the fan alone (with or without inlet vanes) or unit (without inlet vanes) (see dashed lines in Figure 7).
- 5.3.3.6** To determine the actual rating performance values for the specific unit, multiply the percentage values by the wide open cfm, blocked tight static pressure and wide open horsepower of the specific unit's fan alone (with or without inlet vanes) or specific unit (without inlet vanes) at the same **rev/s [rpm]** as in Figure 6 performance curves.
- 5.3.3.7** The same procedure as for 5.3.3.6 applies to multiple fan units, except that the cfm and horsepower values for the fan alone (with or without inlet vanes) are multiplied by the number of fans before applying to the unit, with the restrictions shown in the second paragraph of 5.3.2. Single fan units may be rated from the tests of multiple fan units, but multiple fan units shall not be rated from tests of single fan units.

Section 6. Rating Requirements

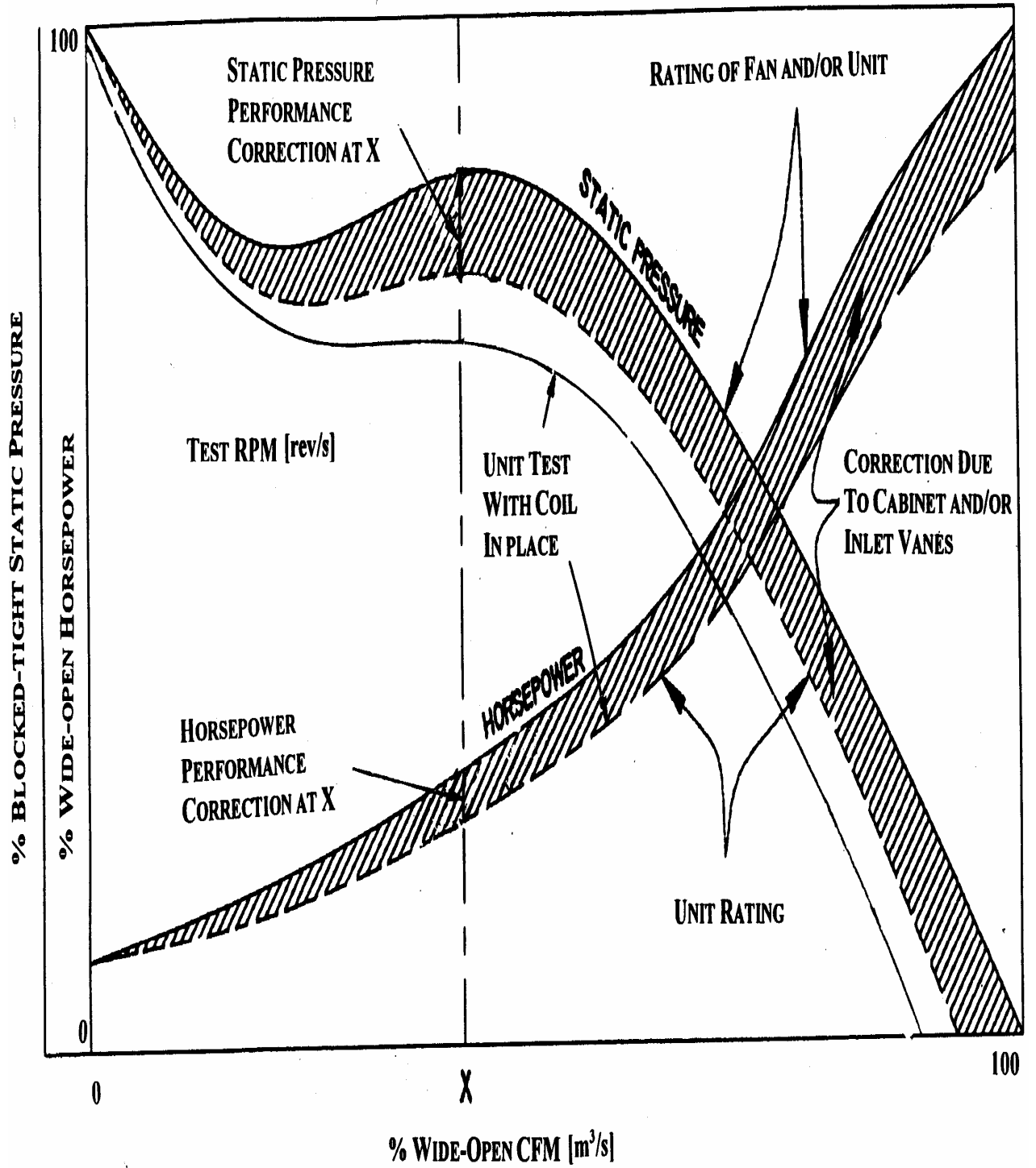
- 6.1** Air-Handling Ratings. Published air-handling ratings shall be expressed in terms of the air quantity, **m³/s [scfm]**; static pressure, in. **kPa [H₂O]** fan speed, **rev/s [rpm]**; and the power required at the fan shaft, brake horsepower, **W [bhp]** based on the procedures outlined in 5.2 and 5.3 of this standard.
- 6.1.1** *Effect of Appurtenances.* The air-handling ratings referred to in 6.1, while based on tests

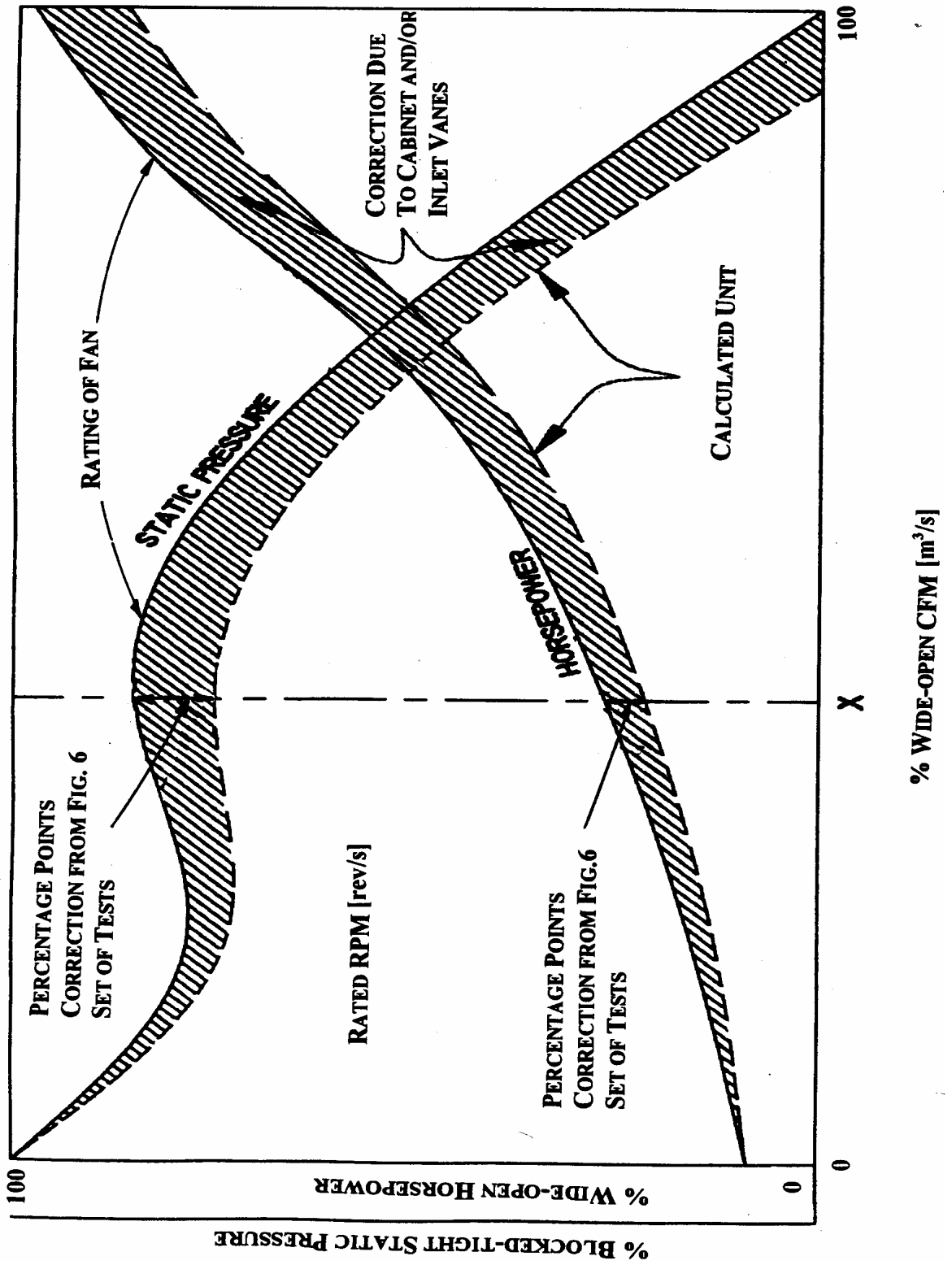
with coil in place, represent the performance of the fan section alone without coil. Thus, as appurtenance such as coils, filters, dampers, etc., are added to the unit, their effects must be taken into account in order to establish the overall performance of the combined unit.

- 6.1.1.1** The manufacturer shall provide the necessary published data and procedures whereby the effects of the appurtenances offered may be taken into account. These effects shall be stated in terms of pressure drop, in. **kPa [H₂O]** measured across the appurtenance over the range of air quantities for which the unit is rated.
- 6.2** *Air-Handling Tolerances.* To comply with this standard, published air-handling ratings shall be such that any unit shall produce its rated volume and pressure with rpm not exceeding the published rated rpm by more than 5% and brake horsepower, **W [bhp]** not exceeding the published rated brake horsepower, **W [bhp]** by more than 7.5%.

Section 7. Minimum Data Requirements for Published Ratings

- 7.1** *Minimum Data Requirements for Published Ratings.* Wherever application ratings are published, they shall include a statement of the conditions at which the ratings apply and be accompanied by the pertinent Standard Rating(s), clearly designated as such. The following information shall be published for all Standard Ratings.
- Static Pressure, in **kPa [H₂O]**
 - Air flow, **m³/s [cfm]**
 - Fan speed, **rev/s [rpm]**
 - Brake horsepower, **W [bhp]**





Section 8. Marking and Nameplate Data

- 8.1** *Marking and Nameplate Data.* As a minimum the nameplate shall display the manufacturer's name and model designation.

Recommended nameplate voltages for 50 Hertz systems shall include one or more of the utilization voltages shown in Table 1 of IEC Standard Publication 38.

Section 9. Voluntary Conformance

- 9.1** *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within its *Purpose* (Section 1) and *Scope* (Section 2) unless such claims meet all of the requirements of the Standard.

APPENDIX A. REFERENCES - NORMATIVE

- A1** Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standards. All references in this appendix are considered as part of the standard.
- A1.1** ANSI/AMCA Standard 210-1997, *Laboratory Methods of Testing Fans for Rating*, 1997, and ANSI/ASHRAE Standard 51, *Laboratory Methods of Testing Fans for Ratings*, 1985 (a single combined standard), American National Standards Institute/Air Movement and Control Association, Inc., 11 West 42nd Street, New York, NY 10036, U.S.A./ 30 West University Drive, Arlington Heights, IL 60004, U.S.A./American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., 11 West 42nd Street, New York, NY 10036, U.S.A./1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.
- A1.2** ARI Standard 410-1991, *Forced-Circulation Air-Cooling and Air-Heating Coils*, 1991, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.
- A1.3** ARI Standard 110-1997, *Air-Conditioning and Refrigerating Equipment Nameplate Voltages*, 1997, Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.
- A1.4** ASHRAE *Terminology of Heating, Ventilation, Air-Conditioning and Refrigeration*, 1991, Second Edition, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.
- A1.5** IEC Standard Publication 38, *IEC Standard Voltages*, 1983, 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** ANSI/ARI Standard 210/240-1994, *Unitary Air-Conditioning and Air-Source Heat Pump Equipment*, 1994, American National Standards Institute/Air-Conditioning and Refrigeration Institute, 11 West 42nd Street, New York, NY 10036, U.S.A./4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.
- B1.2** ARI Standard 340/360-1993, *Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment*, 1993, Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.
- B1.3** ARI Standard 420-1994, *Unit Coolers for Refrigeration*, 1994, Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.
- B1.4** ARI Standard 440-1998, *Room Fan Coils*, 1998, Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.
- B1.5** ARI Standard 840-1998, *Unit Ventilators*, 1998, Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203, U.S.A.

APPENDIX C. CRITERIA FOR PROPORTIONALITY - INFORMATIVE

C1. This appendix sets forth procedures and equations that should be used to determine the proportionality requirements of central standard.

C2 Basis of Proportionality.

C2.1 The following denotes the type of central station unit being rated:

C.2.1.1 "t" refers to a unit with tested performance rating.

C.2.1.2 "c" refers to a unit with calculated performance rating.

C.2.2 Proportional linear dimensions (See Figure C1) are determined using the following generic equation:

$$\frac{(\text{Linear Dimension})_c}{(\text{Linear Dimension})_t} = \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C1)$$

This ratio of the wheel diameters shall not be less than 0.85.

C.2.3 Proportional areas (See Figure C1) are determined using the following generic equation:

$$\frac{\text{Area}_c}{\text{Area}_t} = \left\{ \frac{\text{Diameter}_c}{\text{Diameter}_t} \right\}^2 \quad (C2)$$

C3 Cabinet Proportionality

C3.1 Linear dimensions C, D, E₁, E₂, G (See Figure C1).

C3.1.1 $\frac{C_c}{C_t} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C3)$

C3.1.2 $\frac{D_c}{D_t} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C4)$

C3.1.3 $\frac{E_{1c}}{E_{1t}} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C5)$

C3.1.4 $\frac{E_{2c}}{E_{2t}} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C6)$

C3.1.5 $\frac{G_c}{G_t} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C7)$

3.1.6 The ratio of these distances shall be proportional within ± 1.5 percent.

C3.2 Areas

C.3.2.1 Fan Cabinet Air Inlet

$$\frac{G_c W_c}{G_t W_t} \geq 0.925 \left\{ \frac{\text{Diameter}_c}{\text{Diameter}_t} \right\}^2 \quad (C8)$$

C.3.2.2 Fan Cabinet Air Outlet

$$\frac{S_c T_c}{S_t T_t} \geq 0.925 \left\{ \frac{\text{Diameter}_c}{\text{Diameter}_t} \right\}^2 \quad (C9)$$

C3.2.3 The ratio of these areas shall be proportional within ± 3 percent.

C4.1 Proportional Linear Dimensions.

C4.1.1 Fan Wheel Width.

$$\frac{M_c}{M_t} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C10)$$

C4.1.2 Fan Outlet Width.

$$\frac{K_c}{K_t} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C11)$$

C.4.1.3 Fan Housing Radii

$$\frac{R_{MAXc}}{R_{MAXt}} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C12)$$

$$\frac{R_{MINc}}{R_{MINt}} \geq \frac{\text{Diameter}_c}{\text{Diameter}_t} \quad (C13)$$

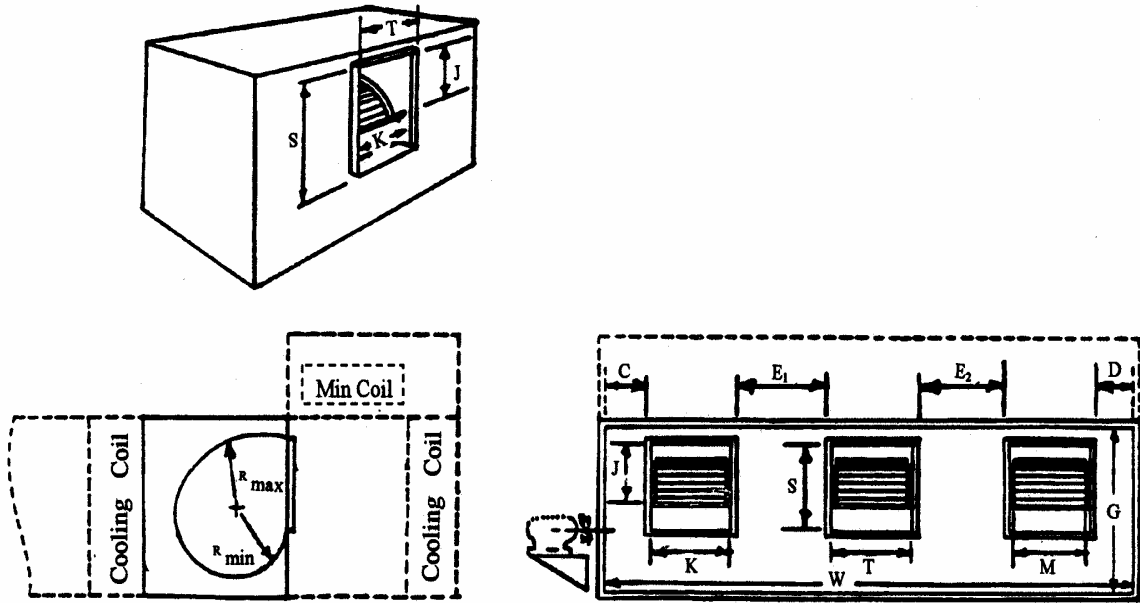
C4.1.4 The ratio of these radii shall be proportional within ± 1.5 percent.

C4.2 Proportional Areas.

C4.2.1 Fan Outlet Area

$$\frac{J_c K_c}{J_t K_t} \geq \left\{ \frac{\text{Diameter}_c}{\text{Diameter}_t} \right\}^2 \quad (C14)$$

C4.2.2 The ratio of these areas shall be proportional within ± 3 percent.



S and T are inside dimensions of the cabinet outlet. R_{min} and R_{max} are measured from the center of the shaft.

Figure C1. Dimensions Used for Proportionality Equations