

AMCA 211-22 (Rev. 01-23)

Certified Ratings Program Product Rating Manual for Fan Air Performance



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AMCA Publication 211-22

(Rev. 01-23)

Certified Ratings Program

Product Rating Manual for Fan Air Performance



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AMCA Publications

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Preface

This edition of AMCA Publication 211, *Certified Ratings Program, Product Rating Manual for Fan Air Performance*, incorporates many major changes to the AMCA International Certified Ratings Program for fans. Many of the changes resulted from experiences gained over the past several years with some of the changes originating with the AMCA International's Fan Committee. Other changes were developed to support and anticipate foreseeable government regulations. All changes were made keeping the needs of the industry in mind along with the needs of the public.

AMCA Publication 211, has been in committee since October 2018. The last revision focused on the introduction of FEI certification into 211. The utility and adoption of FEI is a key strategy for AMCA, with pending regulation referencing this efficiency metric.

This edition of AMCA 211 contains major changes that strategically align AMCA members with their customers and various other regulatory bodies. A summary of these major changes, why they were made and their impact on licensees of the AMCA International Certified Rating Program follow:

1. Changes to AMCA 211-18 check Test Tolerances in Section 10:

A. What changed:

- i. Check test tolerances will be applied to each test point individually as opposed to the entire fan curve at once.
- ii. Each test point will individually have a +/- 5% tolerance on speed to achieve the Point of Rating (POR) while not exceeding 7.5% tolerance on the POR power for shaft-to-air ratings and 10% tolerance on POR power for wire-to-air ratings.

B. Reason for change:

- i. Provides consistency with AHRI 430 tolerances as both are closely aligned.
- ii. Aligns testing validation with field installation and application of fans.
- iii. Regulators will test performance to a Point of Rating, POR (duty point, design point) of airflow, power consumption and static or total pressure.
- iv. Customers in the field can fine tune performance using speed change (VFD or sheave/belts) to achieve desired POR.
- v. With the current check test tolerances, a certified fan (if not certified for efficiency) could have up to a 13% lower than published efficiency in its performance rating and can still pass a test. It was understood in the committee that pending state and federal fan-efficiency regulations would require stricter check test tolerances. The intent is that the new changes will closer align with acceptance of regulators and they will therefore reference this standard and bring stronger reliability to AMCA's Certified Ratings Program.
- vi. Open market test tolerances are aligned with the same methodology, but at a greater tolerance than if supplied directly by the manufacturer.
- vii. During its approval phase, some concerns were shown for products that have been certified over many years without any performance issues (including check tests). These fans may only need a catalog change to meet the new requirements. For currently certified fans, such catalog changes will not be required for three years after final Board approval of this revised publication so that member companies may comply. For new certified products, the requirements would go into effect the first of the month after final Board approval.
- viii. During a check test of a fan certified prior to Final Approval of AMCA 211, if a fan fails using the new check test tolerance and would have passed using the old check test tolerance, and the licensee chooses to re-catalog, the licensee shall re-catalog based on the check test performance. The fan will then be called with normal periodicity, i.e. within 36 months. The normal requirement of a check test within 1 year shall be waived.

2. New Annex I on Speed and Diameter Interpolation:

A. What changed:

- i. Smallest size and lowest speed shall be tested. Fan laws can only be used for 'upward' speed and diameter scaling when one fan speed is tested.
- ii. Diameter and speed interpolation from base test to scaled tests are allowed for catalog data when multiple fan speeds are tested.

B. Reason for change:

- i. To provide better accuracy for low-speed fan performance.
- ii. Interpolation better reflects accuracy of smooth efficiency transitions from small to large size fans rather than 'step' transitions that were resulting from pure Fan laws calculations.
- iii. All rating methods were consistently applied for wire-to-air and shaft-to-air performance.

3. Alternate Test Determination Methods (ATDMs) in Section 8.7:

A. What changed:

- i. This method allows extension of rating factor approach to various pressure loss accessories of a fan like hoods, stack caps, dampers, filters, nozzles, evasés etc. Rating factors shall be verified via precertification tests for 'non-tested' configurations.

B. Reason for change:

- i. This approach minimizes testing burden for manufacturers by utilizing advanced modeling and simulation techniques in fan design.

4. Testing and Calibrating Power Drive Systems (PDS) for air performance / FEI certification in Section 10.6:

A. What changed:

- i. Requirements for testing PDS have been added to the CRP.

B. Reason for change:

- i. Ultimately this total system energy consumption is what the market, our customers and regulators seek.
- ii. This feature enables fan manufacturers to mix and match the performance of PDS (wire-to-shaft) with their fans (shaft-to-air) to create Certified Ratings of Fan/Motor/Drive Systems that could exceed default AMCA 207/208 performance.
- iii. If Sound Power Levels (L_w) are acquired for a PDS, they can be also combined with fan L_{wo} , L_{wi} to determine and certify noise levels for complete fans with motors and drives.

5. Large Diameter Ceiling Fan (LDCF) modification to comply with revised US Federal Regulations in Section 8.3.9.3 and 9.11

6. Added Jet Fan and LDCF seals to better differentiate the distinct types of fan rating programs.

7. Clarified the definition of a "product line" (included examples) and added a definition of a "model" in Section 3.

A. What changed:

- i. Specifically added information regarding product line differentiation for propeller fans.

B. Reason for change:

- i. This clarification may cause some propeller fan product lines to split into more than one product line. This change will help level the playing field for all member companies.
- ii. All product nomenclature, marketing literature and selection program implementation shall be up to the discretion of the fan manufacturers.
- iii. The 'product line' interpretation by AMCA shall go into effect three (3) years after Board approval of this revised publication. This change may affect member companies' catalogs, selection programs, number of products called for check tests and check test scheduling. The three (3) year period will allow member companies to assess the business impact for compliance.

8. Deleted certification of efficiency due to its very limited usage since its inception in 2005. Adoption of FEI by regulatory bodies negates the need for efficiency certification.

9. Manufacturers shall be permitted to assume the compressibility ratio is equal to 1 if the fan total pressure is less than 2,500 Pa (10 in. wg) at any fan air density as outlined in Annex I.

Certified Ratings Program — Product Rating Manual for Fan Air Performance

1. Purpose and Scope

The purpose of this manual is to prescribe technical procedures to be used in connection with the AMCA Certified Ratings Program for fan air performance.

Products that can be certified by AMCA to bear the AMCA certified ratings seals are those defined in ANSI/AMCA Standard 99, Section 0068; ISO 13349; and IEC 60335-2-80 and are within the product scope of AMCA International.

The program applies only to fans and axial impellers.

2. Normative References

10 CFR Part 429.32 – *Ceiling Fans*

10 CFR Part 430, Appendix U to Subpart B, *Uniform Test Method for Measuring the Energy Consumption of Ceiling Fans*

AMCA Publication 11, *Certified Ratings Program Operating Manual*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 99, *Standards Handbook*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

AMCA Publication 111, *Laboratory Accreditation Program*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

AMCA Publication 200, *Air Systems*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

AMCA Publication 311, *Certified Ratings Program Product Rating Manual for Fan Sound Performance*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AHRI Standard 1210, *Performance Rating of Variable Frequency Drives*, Air-Conditioning, Heating, and Refrigeration Institute, 2311 Wilson Blvd, Suite 400, Arlington, VA 22201-3001 U.S.A.

ANSI/AMCA Standard 205, *Energy Efficiency Classification for Fans*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 207, *Fan System Efficiency and Fan System Input Power Calculation*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 208, *Calculation of the Fan Energy Index*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 210, *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 220, *Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 230, *Laboratory Methods of Testing Air Circulating Fans for Rating and Certification*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 240, *Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 250, *Laboratory Methods of Testing Jet Tunnel Fans for Performance*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 260, *Laboratory Methods of Testing Induced Flow Fans for Rating*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/AMCA Standard 300, *Reverberant Room Methods for Sound Testing of Fans*, Air Movement and Control Association International Inc., Arlington Heights, IL USA.

ANSI/ASHRAE Standard 222, *Standard Method of Test for Electrical Power Drive Systems*, ASHRAE, 180 Technology Parkway NW, Peachtree Corners, Georgia 30092 USA

CAN/CSA C838, *Energy efficiency test methods for three-phase variable frequency drive systems*, CSA Group, 178 Rexdale Blvd., Toronto, ON, Canada M9W 1R3

CAN/CSA C747, *Energy efficiency test methods for small motors*, CSA Group, 178 Rexdale Blvd., Toronto, ON, Canada M9W 1R3

HVI Publication 916, *Air Flow Test Procedure*, Home Ventilating Institute, 1740 Dell Range Blvd., Ste. H, PMB 450, Cheyenne, WY 82009 USA

IEC 60335-2-80, *Household and similar electrical appliances – Safety-Part 2-80: Particular requirements for fans*, International Electrotechnical Commission, 3 rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland

IEEE 112-96, *Test Procedure for Polyphase Induction Motors and Generators*, IEEE Standards Association, 501 Hoes Lane Piscataway, NJ 08854-4141 USA

ISO 5801, *Industrial Fans — Performance Testing Using Standardized Airways*, International Organization for Standardization, Geneva, Switzerland.

ISO 13349:2010 – *Fans – Vocabulary and definitions of categories*, International Organization for Standardization, Geneva, Switzerland.

ISO 13350, *Fans – Performance Testing of Jet Fans*, International Organization for Standardization, Geneva, Switzerland.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, International Organization for Standardization, Geneva, Switzerland.

U.S. Environmental Protection Agency's ENERGY STAR program requirements, *Product Specification for Residential Ventilating Fans*, Eligibility Criteria (found on the ENERGY STAR website, www.energystar.gov).

3. Definitions

All definitions in AMCA Publication 11, ANSI/AMCA Standard 99, as well as the following, apply to this program:

3.1 AMCA Certified Ratings Program air performance

A program for certifying a product's aerodynamic performance ratings, as defined in this document.

3.2 Appurtenance

Any item in or on the inlet or discharge airstream that affects the performance of the fan. An accessory is henceforth referred to as an appurtenance.

3.3 As-run speed

The test results are reported at the fan test speed.

3.4 Axial impeller

An impeller in which airflow enters and exits substantially parallel to the shaft axis, designed to operate in an orifice, partition or bell-mouth structure. See Figure A.38 for mandatory dimension reporting requirements.

See Section 13.1.4 for a sampling of different propeller shapes that shall constitute a method of differentiating product lines.

3.5 Ceiling fan energy index (CFEI)

A ratio of the electrical input power of a reference ceiling fan to the electrical input power. CFEI is calculated in accordance with ANSI/AMCA Standard 208, with the modifications listed in Section 8.3.9.3.c.

3.6 Constant speed

Test data are converted to a single speed before catalog data are generated.

3.7 Fan efficiency grade (FEG)

A metric defined by ANSI/AMCA Standard 205 that represents an efficiency grade for fans without consideration of the drives.

3.8 Fan energy index (FEI)

A ratio of the electrical input power of a reference fan to the electrical input power as defined by ANSI/AMCA Standard 208.

3.9 Free inlet

Without a duct on the inlet.

3.10 Free outlet

Without a duct on the outlet.

3.11 Model

A product line subdivision that identifies unique physical attributes that result in varied performance from other products in the line. For example, size is a common attribute that would distinguish a model in a product line. Optional appurtenances would not be considered as separate models.

3.12 Performance rating(s)

A statement of the pressure performance and power vs. airflow at a given speed at standard inlet air density or other specified density. Efficiency also may be included in the performance ratings at the option of the licensee. Power shall be specified as impeller, shaft or electrical input power as appropriate. The rating may be published in tabular and/or graphical format. Specific performance rating requirements are given in the product rating requirements sections of this document.

3.13 Power drive system (PDS)

An adjustable speed electric alternating current (AC) PDS, which includes a complete drive module and motor.

3.14 Product line

A series of fan models with a common design purpose and similar aerodynamic features (or an individual product where only one size is offered for sale) that are cataloged under the same product description name and/or identifying reference and are within this program's scope. Significant differences in blade construction, for example, a change from single thickness to airfoil blade or different blade shapes shall constitute different product lines. Figures 3a – 3d show examples of designs that shall constitute different product lines. Modifications that do not differentiate product lines may include changes in pitch angle at a designated radius, hub-to-tip ratio or solidity (number of blades).

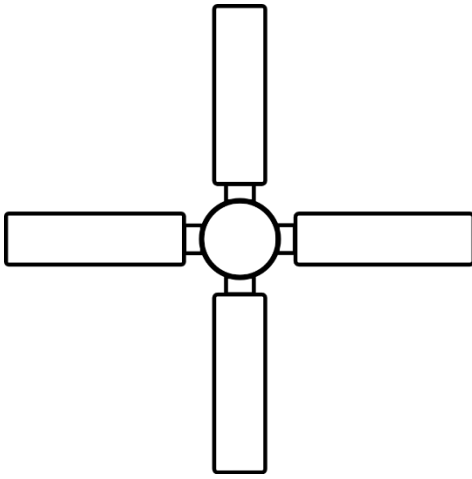


Figure 3a — Straight Blade

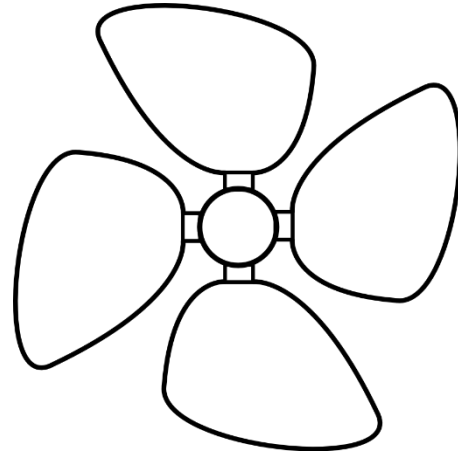


Figure 3b — Paddle Blade

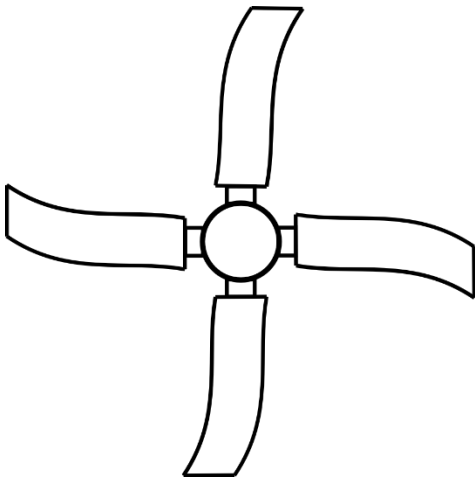


Figure 3c — Forward/Backward Swept

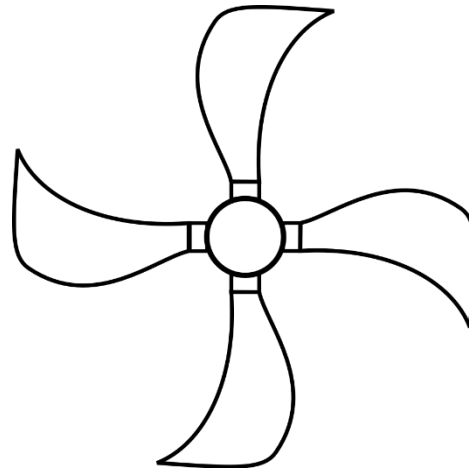


Figure 3d — Sickle Blade

3.15 Shall and should

The word *shall* is understood to be a mandatory requirement, and the word *should* is understood to be advisory.

3.16 Single room air handler

An encased assembly consisting of a fan(s) and at least one electric motor. It may include additional components to condition and/or control the air. Only single inlet/outlet testing may be used for ratings.

4. Data Submittal Requirements

The following data shall be submitted with the CRP-8 application form:

- Test data for each test conducted (observations of all variables measured for each test point), which must conform to the test standard used.
- Results of the test(s) converted to standard air density and constant speed, where applicable.
- Drawings of each size of the product line, showing the dimensions specified in Annex A for the type of product being submitted.
- Photograph of each test setup.

5. Drive Methods

Various methods may be used to drive the test unit and measure the power input to the fan. The power measurements may or may not include the power transmission losses, but for fans supplied with shaft and bearings, the bearing losses shall be included in the fan power input measurement. See Annex D for more information about allowable methods of accounting for bearing and/or power transmission losses when calculating test data to othersizes and speeds.

Direct driven fans using “low-slip” motors (e.g., squirrel cage induction motors) may be driven by a dynamometer or a calibrated motor when the fan power rating is the output power of the dynamometer or calibrated motor. When the fan power rating is the motor input power, the fan shall be driven by its own motor. Direct driven fans using “high slip” motors (e.g., shaded pole or capacitor start motors) shall be driven by those motors, and the power rating shall be the motor input power.

Motor calibrations shall be performed by an AMCA laboratory, or a laboratory accredited for the appropriate motor test standard(s) under AMCA 111 or ISO 17025. Motor calibrations shall be performed at the voltage and frequency to be used for the fan test and shall be conducted at the motor’s operating temperature.

If fan systems include electric drivers (e.g., variable frequency drives [VFDs] or electronically commutated motors), then the input power is the electrical power consumed by the electric drive.

6. Ducted Inlet Simulation

Ducted inlet performance may be simulated by using an inlet bell or an inlet bell and one diameter of inlet duct.

7. Catalog Requirements

7.1 Scope of certification

This certified ratings program applies to fans within the scope of AMCA for which performance rating catalogs are published and made available to the public. When only a portion of a cataloged series of sizes are certified, a majority of the sizes cataloged shall be certified. It does not apply to special units for which performance ratings are not published. When performance ratings for both certified and non-certified products are contained in the same catalog, there must be a clear distinction made between them, as required in AMCA Publication 11, Section 11. The same requirement applies if some catalog performance data are not certified.

7.2 Statement required adjacent to the AMCA Certified Ratings Program seals

7.2.1 Certified products statement

In catalogs containing ratings of certified products, the following statement shall be printed prominently and immediately adjacent to the reproduction of the AMCA certified ratings seals, except as noted in Section 10.5 of AMCA Publication 11:

“[Licensee’s name] certifies that the [product description] shown herein [is/are] licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 (and AMCA Publication 311 if sound is also certified) and comply with the requirements of the AMCA Certified Ratings Program.”

7.2.2 Additional FEI, CFEI and FEG statement requirements

In cases in which some models within a product line are FEI, CFEI or FEG certified, but others are not, provide the following statements in addition to the qualifying statement stated above:

“The AMCA Certified Ratings Program seal applies to air performance (and sound) for models [XXX] (or models on pages [XX-XX]) only.”

“The AMCA Certified Ratings Program seal applies to the [add as appropriate: FEI, CFEI, FEG] for models [XXX] (or models on pages [XX-XX]) only.”

7.3 Application statements

The qualifying statements required in the rating method details (sections 9.1 through 9.11) shall be shown immediately adjacent to the ratings, not with the seal.

7.4 Noncertified FEI, CFEI, FEG and/or sound ratings

Where noncertified FEI, CFEI, FEG and/or sound ratings are shown adjacent to the certified air performance ratings, the following statement shall be shown prominently adjacent to the noncertified ratings:

“The AMCA certified ratings seal applies to air performance [add as appropriate: sound, FEI, CFEI, FEG ratings] only.”

7.5 The AMCA Certified Ratings Program seals

All AMCA Certified Ratings Program seals can be seen on the AMCA website (www.amca.org)

7.5.1 FEG seal usage

7.5.1.1 All models FEG certified

Use the AMCA sound and air performance seal, AMCA FEG seal or AMCA air performance FEG seal, whichever is applicable, with the qualifying statement, as usual. The blue and yellow AMCA seal also may be used if desired.

7.5.1.2 Some models FEG certified

Use the AMCA sound and air performance seal or AMCA air performance seal, whichever is applicable, for models not AMCA certified for FEG. Additionally, use the AMCA sound and air performance FEG seal, AMCA air performance FEG seal or generic FEG seal for models that are AMCA certified. See Section 7.2.2 for additional statement requirements.

7.5.2 Certification/seal types

See Table 7.1 for seal types available for each certifiable product type

7.6 FEI label requirements

See Annex G regarding labeling requirements for fans with a regulated FEI.

7.7 Further information

See Section 9 for further information on qualifying statements and use of the AMCA Certified Ratings Program seals.

8. Fan Performance Ratings

8.1 Manufacturer's responsibility

The fan manufacturer is responsible for developing fan performance ratings for its production fans that perform within the tolerances established by the AMCA Certified Ratings Program as defined in Section 10. Separate product rating requirements sections define specific requirements for each type of product. Licensees shall certify their products based on test methods appropriate for the designed purpose of the fan (e.g., a jet fan cannot be certified based on a circulating fan test).

8.2 AMCA International staff's responsibility

AMCA International staff is responsible for the administration of the AMCA Certified Ratings Program by verifying that the manufacturer's air performance ratings were developed in accordance with the requirements of this program.

AMCA International staff is also responsible for verifying that the catalog published by the licensee conforms to the program requirements.

8.3 Ratings development

8.3.1 General requirements

The air performance rating of a fan or a series of similar fans is developed from tests conducted in accordance with ANSI/AMCA Standard 210, ISO 5801 or other testing standards recognized in AMCA Publication 111, using the same standardized airways.

The manufacturer is responsible for determining the product sizes to be tested and the number of tests that must be performed to provide the data necessary for the development of certified ratings.

8.3.2 Conversion formulae

Calculation to other sizes and speed will be performed in accordance with Annex I and the appropriate product rating sections.

8.3.3 Geometrically similar products

Products of different materials, such as steel vs. aluminum, or fiberglass vs. carbon fiber, where differences in thickness are small, shall be considered geometrically similar. Products using materials with large thickness or roughness variations, such as steel vs. fiberglass, are not considered similar. Where differences in thickness or roughness are large, the manufacturer shall demonstrate similarity through comparison testing. Refer to Annex D.

8.3.4 Appurtenances

An appurtenance should be considered a part of the fan if it is in place when the fan is tested for a performance rating, and the effect of the appurtenance is included in the cataloged performance rating.

Table 7.1 -- Seal Availability and Method of Test (MOT) Standards for Product Types

Product Types →	Centrifugal and mixed flow fans	Axial fans	PRVs	Prop fans	Air curtain Units	Circulating fans	Agricultural fans	Induced flow fans	PPVs	Jet fans	Large diameter ceiling fans	Axial props	Evaporative coolers	ERV/HRV	Ceiling ventilators
Seal Type															
Air	X	X	X	X	X							X	X	X	X
Sound & air	X	X	X	X	X								X	X	X
cfm/watt							X								X
cfm/watt, sound							X								X
PPV									X						
Circulating fan						X									
FEG, air	X	X	X	X											X
FEG, sound and air	X	X	X	X											X
Induced flow fan (IFF) air								X							
IFF air and sound								X							
IFF air and FEG								X							
IFF air, sound and FEG								X							
FEI, air	X	X	X	X			X								X
FEI, air, and sound															X
FEI, IFF air								X							
FEI, IFF air and sound								X							
Jet fan -thrust										X					
Jet fan -thrust and sound										X					
FEI, jet fan thrust & sound										X					
FEI, circulating fan						X									
LDCF air											X				
LDCF air & CFEI											X				
MOT Standard															
AMCA 210	X	X	X	X	X							X	X	X	X
ISO 5801	X	X	X	X	X										
AMCA 220					X										
AMCA 230						X					X				
AMCA 240									X						
AMCA 250										X					
ISO 13350										X					
AMCA 260								X		X					
AMCA 300	X	X	X	X	X					X					X
ISO 13347-2	X	X	X	X	X										X
AMCA 320	X	X	X	X											X
ISO 13347-4	X	X	X	X											X

A fan may include various appurtenances that affect its air performance, the effect of which may or may not be included in the fan's performance rating. Other appurtenances may affect the power absorbed, which also may or may not be included in the fan's performance rating.

8.3.5 Catalog performance rating

The performance rating is applicable only to the fan configuration tested, including any appurtenances tested with the fan. Statements of total (mechanical) or static efficiency may be included as part of the rating.

8.3.6 Bearings and shafts

If a fan impeller is provided with bearings, it shall be tested on its own shaft and bearings. The bearings shall be unmodified commercially available bearings but may be "run in" to simulate the losses occurring in practice.

8.3.7 Bi-stable operating region

When a fan shows a region of bi-stable operation in the certified range, the catalog data for that range shall be based upon tests that yield the lower pressure and corresponding power. The manufacturer shall inform AMCA if bi-stable operation for the fan is possible and if any appropriate requirements for the test procedures are known.

8.3.8 Published ratings

The catalog data published under the AMCA Certified Ratings Program shall contain the information listed for each rating method.

For all ratings methods, the following statement shall be shown immediately adjacent to the ratings tables, graphs or charts:

"Performance certified is for installation type (list one or more of the following types)."

- A. Free inlet, free outlet with partition
- B. Free inlet, ducted outlet
- C. Ducted inlet, free outlet
- D. Ducted inlet, ducted outlet
- E. Free inlet, free outlet without partition

8.3.9 Efficiency Metrics (FEG, FEI, CFEI)

8.3.9.1 FEG certification

Fan Efficiency Grades (FEGs) are based solely on fan total pressure. To be eligible to bear one of the AMCA FEG seals, the requirements detailed in sections 8.3.9.2.a. through 8.3.9.2.c. must be met.

a. Prerequisites and requirements

The air performance of the product line must be AMCA certified to obtain the AMCA Certified Ratings Program FEG seal. An entire product line or individual models within a product line may obtain FEG certification. A model that has its FEG certified may display the FEG rating (not the seal) on its nameplate. There is no minimum number of models required to be certified in each product line. All products that are certified to bear the AMCA Certified Ratings Program FEG seal shall be identified in AMCA's directory of certified products.

b. Eligibility

The following fan types in AMCA Publication 211 are ineligible to obtain the AMCA Certified Ratings Program FEG seal:

- Air curtain units
- Energy recovery ventilators (ERVs)/heat recovery ventilators (HRVs)
- Positive pressure ventilators (PPVs)

c. Determination of FEG

Certified FEGs are determined in accordance with ANSI/AMCA Standard 205. The data used in the determination of a model's FEG will be based on that its base test data as referenced in the product line's CRP-8 application form. If the base test data is not available or incomplete, the FEG will be based on the model's certified catalog performance.

If cataloged data is used and the only certified power is the maximum fan input power, the determination of that model's FEG shall be based on the base data that was used to generate the catalog data.

Note: As defined in ANSI/AMCA Standard 205, the FEG classification applies only to fans of 750 W (1 hp) or greater.

If an axial flow fan is certified in multiple pitches and the customer is able to change the pitch, the FEG is based on the peak total efficiency within the range of pitches certified.

d. FEG catalog requirements

FEGs shall be displayed either in the product line's approved catalog, listed in AMCA's directory of certified products or both. To be listed in the directory of certified products, written authorization must be received from the licensee. If listed in the directory of certified products, the peak fan total efficiency will be listed with that model's FEG.

8.3.9.2 FEI certification and scope

FEI values shall not be published for duty points below 125W air power (based on static pressure), and airflow below 2 m³/s (4238 cfm). If the air power is at or above 125W or if airflow is at or above 2 m³/s (4238 cfm), FEI values may be published.

To be eligible to bear one of the AMCA Certified Ratings Program FEI seals, the following requirements must be met.

a. Prerequisites

The air performance of the product line must be AMCA International certified. An entire product line or individual model within a product line may obtain FEI certification. See Annex G for more information.

b. Eligibility

The following fan types within AMCA Publication 211 are ineligible to obtain the AMCA Certified Ratings Program FEI seal:

- Air curtains
- PPVs
- Evaporative coolers
- Energy (or heat) recovery ventilators
- Large diameter ceiling fans
- Any fans not within the scope of ANSI/AMCA Standard 208

c. Calculation of FEI

Certified FEIs are calculated in accordance with ANSI/AMCA Standard 208. The published data of each model number shall include the following:

Choice of:

- "FEI calculation is based on default motor calculation in accordance with ANSI/AMCA Standard 208".
- Motor power and number of poles for regulated motor and motor controller capacity (if any). For example, "FEI calculation is based on 5 HP, 4 pole IE3 motor."
- Motor power, speed, and nominal efficiency for unregulated motor and motor controller capacity (if any). For example, "FEI calculation is based on 5HP, 1800 rpm, 89% efficient motor with 5 HP VFD".
- "FEI calculation is based on wire-to-air tests."

8.3.9.3 CFEI certification

To be eligible to bear the AMCA CFEI seal, the following requirements must be met:

a. Prerequisites

The air performance of the product line must be AMCA International certified. An entire product line or individual model within a product line may obtain CFEI certification.

b. Eligibility

Large diameter ceiling fans are eligible to obtain the AMCA CFEI certification seal:

c. Calculation of CFEI

Certified CFEIs are determined in accordance with 10 CFR Part 430, Appendix U to Subpart B and Section 429.32 of 10 CFR Part 429 (including minimum sample size) or ANSI/AMCA 230 and ANSI/AMCA Standard 208.

8.3.10 Electrical input with unregulated motors and controllers

For determining electrical input power with unregulated motors and controllers, see Annex H.

8.3.11 Wire-to-air measurements: Calculations to other speeds and densities

For determining how to interpolate wire-to-air efficiencies, see Annex I.

8.4 Catalog data

All proposed catalog data is checked against the reference test data. The catalog data is considered satisfactory if it is within one-quarter of the equivalent check test tolerance. Conservative ratings may be cataloged.

8.5 Alternate performance determination methods (APDM)

As technologies advance in product design, proprietary methods are acceptable to establish product performance ratings. These methods can include computational fluid dynamics (CFD), empirical modeling techniques, a combination of testing and modeling or other advanced techniques. Performance data can be determined by any of these methods and submitted to AMCA International as part of the Certified Ratings Program.

8.5.1 APDM validation

To validate an APDM, a description of the method used must be provided to AMCA International per the member confidentiality agreement along with proposed rating data developed from the APDM. Precertification tests will be required as follows: Instead of a single comparison between the AMCA International testing laboratory (or independent laboratory) test data and the applicant's submitted test data, multiple tests at the AMCA International testing laboratory (or independent laboratory) will be compared with the applicant's APDM data. For every varied fan parameter in the APDM (e.g., axial blade pitch, number of blades, hub-to-tip ratio, centrifugal impeller width, etc.), all combinations of the maximum and minimum values of the parameter not tested by the licensee will be tested and compared with the predicted values. For example, if a licensee has developed an APDM for an axial fan line in which the blade pitch angle, number of blades and hub diameter vary for each size, then eight (2x2x2) fan tests would be required to validate the APDM.

For each fan, AMCA International shall choose a configuration of parameters not previously tested by the applicant. The fans will be tested and compared with the submitted APDM data.

8.5.1.1 Application of check test tolerances

Prior to the precertification tests, the applicant must submit to AMCA International all APDM data to be used for catalog certification. The check test tolerances as described in Section 10 shall be applied to each precertification test. If the tested performance is within the tolerances as described in Section 10, the APDM is accepted and the APDM results shall be used for the catalog performance check.

8.5.1.2 Precertification test failures

If any precertification test fails, the applicant will be informed and given the opportunity to inspect the fan for damage or defects. If any damage or defects are found, the applicant shall repair or correct the product and the test will be repeated. If no shipping damage occurred, the licensee shall modify the APDM and a new precertification fan(s) shall be selected and tested to validate the modified APDM. If the fan passes the retest the APDM is accepted. If it fails, the APDM is rejected and the applicant can choose to develop a new APDM; the process starts over with a new ratings data submittal and precertification test units.

8.5.2 Catalog checks for fans using APDM

The catalog checks performed for a product line using an APDM will employ either base tests, if applicable, or the APDM data submitted prior to the precertification tests.

8.6 Alternate electrical input determination method (AEDM)

This option shall specifically consider the wire-to-air electrical input metric, fan electrical input power (FEP) as defined in ANSI/AMCA Standard 207, to be used with fan-only ratings. The focus here is to consider AEDM methods that allow the certification of fans, motors and controls. Fan-only ratings are combined with motor and control performance ratings that are either provided by the motor/control manufacturer or tested in an AMCA International or ISO/IEC 17025 accredited laboratory.

8.6.1 AEDM validation

To validate the AEDM, a description of the method used must be provided to AMCA International per the member confidentiality agreement, along with the proposed ratings data developed from the AEDM. Precertification tests will be required as follows: Instead of a single comparison between the AMCA International testing laboratory (or independent laboratory) test data and the applicant's submitted test data, multiple tests at the AMCA International testing laboratory (or independent laboratory) shall be compared with the AEDM. Two tests per parameter shall be performed as follows, similar to the APDM approach for fans:

1. For every motor type and control in the AEDM (e.g., induction, permanent magnet, electronically commutated motor [ECM]) the maximum speed in cataloged range, or two speeds if a control is used (max, (max-speed range/2)), shall be tested and compared with the predicted FEP values. For example, if an applicant has developed an AEDM for an ECM, two speeds shall be required to validate it.
2. Combinations of the maximum and minimum values of the motor output power, not tested by the licensee, shall be tested and compared with the predicted FEP values.

For example, a total of eight (2x2x2) tests (two types of motors, two speeds, two motor output power ratings) shall be performed to validate the AEDM. FEP predictions from fan input power may be done using algorithms from ANSI/AMCA Standard 207 or other proprietary methods.

8.6.1.1 Application of check test tolerances

Prior to the precertification tests, the applicant must submit to AMCA International all AEDM data to be used for certification. The check test tolerances as described in Section 10 shall be applied to each precertification test. The tolerances for fan input power shall be applied to the FEP, as they are both "power" quantities. If the test is within the tolerances as described in Section 10, the AEDM is accepted and the predicted results shall be used for the catalog performance.

8.6.1.2 Precertification test failures

If any precertification test fails, the applicant will be informed and given the opportunity to inspect the fan for damage or defects. If any damage or defects are found, the applicant shall repair or correct the product and the test will be repeated. If no shipping damage occurred, the licensee shall modify the AEDM and a new precertification fan(s) shall be selected and tested to validate the modified APDM. If the fan passes the retest the AEDM is accepted. If the comparison fails, the AEDM is rejected and the applicant can choose to develop a new APDM; the process starts over with a new ratings data submittal and precertification test units.

8.6.2 Catalog checks for fans using AEDM

The catalog checks performed for a product line using an AEDM will employ base tests, if applicable, or the AEDM data submitted prior to the precertification tests.

8.7 Alternate testing determination methods (ATDM)

A certified product line may be used as the basis for a different product line when a modification is made, either permanently or as a detachable component to the existing product line using passive components. Examples include but are not limited to inlet/ discharge stack caps, hoods, filters, discharge nozzles, evasés, transitions, guide vanes, fans in a box with varying wall spacings etc. These modifications could either enhance or diminish the original fan performance.

The effect of the modification is determined by comparing tested fan curves with and without the modification. The difference between these fan curves, or rating factor, is normally quantified as a percentage of the inlet or discharge velocity pressure of the component used to modify the base fan's performance. When multiple sizes are tested, this rating factor is compared with (or curve fit to) the model size or other pertinent dimensions.

Performance data can be determined with any of these methods and submitted to AMCA International as part of the Certified Ratings Program.

8.7.1 ATDM validation

To validate an ATDM, a description of the method used must be provided to AMCA International per the licensee's confidentiality agreement along with proposed testing and rating data developed from the ATDM. Precertification tests will be required as follows: Instead of a single comparison between the AMCA International testing laboratory (or independent laboratory) test data and the licensee's submitted test data, one test for each unique modification, on a non-tested size – different from those used for rating factor development – shall be conducted at the AMCA International testing laboratory (or independent laboratory). This precertification test result/results shall be compared with the licensee's ATDM data to determine overall pass/ fail result.

For each product line, AMCA International shall choose a configuration of parameters not previously tested by the licensee. The fans will be tested and compared with the submitted ATDM data. The precertification test tolerances shall be applied to each precertification test. If the tested performance is within the tolerances as described in Section 10, the ATDM is accepted and the ATDM results shall be deemed acceptable.

The predicted efficiency for each model calculated by applying the ATDM may not be more than five percent greater than the fan efficiency determined from the corresponding test of the model. The predicted airflow and pressure for each model calculated by applying the ATDM may not be more than the tolerance for airflow and pressure in Section 10

8.7.1.1 Precertification test failures

Prior to the precertification tests, the licensee shall submit to AMCA International all ATDM data to be used for catalog certification. If any precertification test fails, the licensee will be informed and given the opportunity to inspect the fan for damage or defects. If any damage or defects are found, the licensee shall repair or correct the product and the test will be repeated. If no shipping damage occurred, the licensee shall modify the ATDM and a new precertification fan(s) shall be selected and tested to validate the modified ATDM. If the modification of the ATDM affects models other than the failed model, the licensee shall submit the revised catalog. If the fan passes the retest(s), then the ATDM is accepted. If the comparison fails, the ATDM is rejected and the licensee can choose to develop a new ATDM; the process starts over with a new ratings data submittal and precertification test units.

8.7.1.2 Catalog checks for fans using ATDM

The catalog checks performed for a product line using an ATDM will employ either base tests, if applicable, or the ATDM data submitted prior to the final precertification tests.

8.7.1.3 Application of check test tolerances

The check test tolerances as described in Section 10 shall be applied to each precertification test. If the tested performance is within the tolerances as described in Section 10, the ATDM is accepted and the ATDM results shall be used for the catalog performance check.

9. Ratings Method Details

A summary of available ratings methods is found in Annex F.

9.1 Rating method A/B/D: Centrifugal, mixed-flow, axial, propeller fans, power roof ventilators (PRVs), energy recovery ventilator (ERVs) and axial impellers (constant speed rating method)

This method applies to the following:

- Belt drive units with integral shaft and bearings rated at a constant speed.
- Direct drive units with low-slip motors rated at a constant speed.

9.1.1 Calculated performance

The test fan performance shall be used as the basis for calculating the performance of the test fan to other speeds, a larger fan or a series of larger fans using the fan laws or a validated APDM. See Annex D for more information. Calculating to other speeds for direct drive fans requires measuring fan input power.

9.1.2 Published data

The performance ratings of each model number shall include the following:

- Volumetric airflow rate
- Fan static pressure and/or fan total pressure
- Choice of (one or more):
 - Fan input power;
 - Maximum fan input power over the range cataloged;
 - Fan input power at the stated duty;
 - Maximum motor (or motor control) input power, nominal efficiency and/or motor model number, voltage and frequency over the range cataloged
 - Motor (or motor control) input power, nominal efficiency and/or motor model number, voltage and frequency at the stated duty.
- Impeller speed
- Inlet air density (if other than standard air)
- If publishing axial impeller ratings, see Figure A.38 and include:
 - D Impeller diameter
 - CL Cylinder length
 - Tip Tip clearance
 - G Geometry of inlet shape
 - T Position of the impeller
 - DD Driver distance

If the model is also certified for FEI or FEG, the performance ratings shall include the corresponding certified values.

Note: The “maximum fan input power over the range cataloged” is the peak input power value between the values at the greatest airflow and lowest airflow in all approved catalogs.

The following statements shall be shown immediately adjacent to the ratings tables, graphs and/or charts and may be identified by a footnote when appropriate:

“Power rating does not include transmission losses.”

Or:

“Power rating includes transmission losses.”

Note: “Transmission losses,” as used in these statements, may refer to belt drive losses, motor losses, control losses or losses caused by the addition of appurtenances, such as shaft seals, etc. Bearing losses and coupling losses are included in the power rating.

One of the following statements appropriate for the product being rated shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Performance ratings do not include the effects of appurtenances.”

Or:

“Performance ratings include the effects of [list appurtenances here].”

In addition, for axial impellers, the following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Operation of the axial impeller in a configuration different from the published test configuration will affect performance.”

See Annex D for additional ratings information.

9.2 Rating method C/E: centrifugal, mixed-flow, axial, propeller fans, PRVs, ERVs, axial impellers and single room air handlers (as-run speed rating method)

This method applies to the following:

- Belt drive units with integral shaft and bearings featuring low slip motors rated at an as-run speed.
- Direct drive units with low slip motors rated at an as-run speed.

The actual speed cannot differ from the nominal speed by more than 3%. Power transmission losses are included in the fan power rating.

Note: “Nominal speed” is a speed midway between the highest speed of any cataloged rating point and the lowest speed of any cataloged rating point rounded to the nearest 5 rpm.

9.2.1 Calculated performance

The test fan performance shall be used as the basis for calculating the performance of the test fan to other as-run speeds, the performance of a larger fan size or a series of larger fan sizes using the fan laws. See Annex D for more information. The speed used for the calculated performance shall be based on the ratio of the test fan speed at each test point to the test fan nominal speed times the nominal speed of the calculated fan.

Calculating to other speeds for direct drive fans requires measuring fan input power.

9.2.2 Published data

The performance ratings of each model number shall include:

- Volumetric airflow rate
- Fan static pressure and/or fan total pressure
- Choice of (one or more):
 - Maximum fan input power over the range cataloged;
 - Fan input power at the stated duty;
 - Maximum motor (or motor control) input power, nominal efficiency and/or motor model number, voltage and frequency over the range cataloged
 - Motor (or motor control) input power, nominal efficiency and/or motor model number, voltage and frequency at the stated duty.
- Actual impeller speed at each point of rating or at the nominal speed
- Inlet air density (if other than standard air)
- If publishing axial impeller ratings, see Figure A.38 and include:
 - D Impeller diameter
 - CL Cylinder length
 - Tip Tip clearance
 - G Geometry of inlet shape
 - T Position of the impeller
 - DD Driver distance

If the model is also certified for FEI or FEG, then the performance ratings shall include the corresponding certified values.

Note: The “maximum fan input power over the range cataloged” is the largest recorded input power value between the values at the greatest airflow and lowest airflow in all approved catalogs.

When a nominal speed is cataloged, the following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Speed shown is nominal. Performance is based on actual speed of test.”

One of the following statements appropriate for the product being rated shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Performance ratings do not include the effects of appurtenances.”

Or:

“Performance ratings include the effects of [list appurtenances here].”

For belt driven fans, the following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts and may be identified by a footnote when appropriate:

“Power rating includes transmission losses.”

Additionally, for axial impellers, the following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Operation of the axial impeller in a configuration different from the published test configuration will affect performance.”

9.3 Rating method F: Centrifugal, mixed-flow, axial, propeller fans, PRVs, ERVs, axial impellers and single room air handlers

This method applies to direct driven units with high slip motors rated at an as-run speed where the actual speed varies over the cataloged range of fan performance by more than 3%.

9.3.1 Calculated performance

No calculations to other sizes are permitted. For calculations to other speeds, Annex I shall be utilized.

In the case of multiple speed high slip motors (shaded pole, permanent split capacitor, universal, etc.), the performance rating shall be as-run for each speed based on tests at each speed.

9.3.2 Published data

The performance ratings of each model number shall include:

- Airflow rate
- Fan static pressure and/or fan total pressure
- Maximum motor (or motor control) input power, nominal efficiency and/or motor model number, voltage and frequency over the range cataloged, or motor input power, voltage and frequency at the stated duty (optional if less than 500 W)
- Actual impeller speed at each point of rating or a nominal speed
- Inlet air density (if other than standard air)
- If publishing axial impeller ratings, see Figure A.38 and include:
 - D Impeller diameter
 - CL Cylinder length
 - Tip Tip clearance
 - G Geometry of inlet shape
 - T Position of the impeller
 - DD Driver distance

If the model is also certified for FEI or FEG, then the performance ratings shall include the corresponding certified values.

The nominal speed shall be approximately in the middle of the actual speed range over the performance range cataloged.

When a nominal speed is cataloged, the following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Speed shown [rpm] is nominal. Performance is based on actual speed of test.”

One of the following statements appropriate for the product being rated shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Performance ratings do not include the effects of appurtenances.”

Or:

“Performance ratings include the effects of [list appurtenances].”

Additionally, for axial impellers, the following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“Operation of the axial impeller in a configuration different from the published test configuration will affect performance.”

9.4 Rating method G: Air curtains

Air curtains may be direct or belt driven. Power transmission losses, if any, are included in the power rating.

9.4.1 Calculated performance

9.4.1.1 Air performance

The test air curtain air performance ratings may be used as the basis for calculating the air curtain performance at other speeds using the fan laws. See Annex D for more information.

If motor input power is measured during the air performance test, fan input power may be calculated using the motor calibration curve for the motor used during the test. Fan input power at other speeds then may be calculated using the fan laws. Motor input power then may be calculated using a motor calibration curve for the motor typically supplied with the air curtain at the rated speed.

If fan input power is measured during the air performance test, fan input power may be used to calculate fan input power at other speeds using the fan laws. A motor calibration curve for the motor typically supplied with the air curtain shall then be used to determine the motor input power at the rated speed.

9.4.1.2 Multiple identical modules

Where the test of a single module is used to rate a unit composed of a group of identical modules, the airflow rate shall be the airflow rate of the single module times the number of identical modules. The power rating for a combination of identical modules shall be the input power of the single module times the number of identical modules.

Where the airflow rate of a single module is derived from a test of a unit comprised of multiple identical modules, the airflow rate of each single module shall be the total airflow rate of the unit divided by the number of modules. The power rating of a single module shall be the total motor input power of the unit divided by the number of modules.

9.4.1.3 Dissimilar multiple modules

Where necessary, airflow rate and module power shall be determined from a comparative test of units made up of dissimilar modules.

Example:

Air Curtain Construction	
Unit No. 1	Unit No. 2
3 A modules + 1 B module	2 A modules + 1 B module

The airflow rate of Module A is the airflow rate of Unit No.1 less the airflow rate of Unit No. 2. The motor input power rate of Module A is the input power of Unit No.1 less the input power of Unit No. 2

Subsequently, the airflow rate of Module B is the airflow rate of Unit No.1 less three times the airflow rate of Module A. The motor input power of Module B is the motor input power of Unit No. 1 less three times the input power of Module A.

9.4.1.4 Average outlet velocity

The average outlet velocity for a single module or a combination of modules shall be the airflow rate divided by the face area of the discharge nozzle.

9.4.1.5 Outlet velocity uniformity

In an air curtain unit comprised of multiple modules, the unit's outlet velocity uniformity shall be equal to that of the module with the lowest uniformity in the unit.

9.4.1.6 Velocity projection

The velocity projection for a combination of identical modules is the same as the velocity projection found from the test of one of the single modules.

The velocity projection test of a unit with multiple identical modules shall not be used to determine the velocity projection of a single module.

The velocity projection of units comprised of multiple dissimilar modules shall not be derived from tests of single modules.

9.4.2 Published data

The performance ratings of each model number shall include the following:

- Volumetric airflow rate
- Average outlet velocity
- Motor input power, nominal efficiency and/or motor model number, voltage and frequency
- Outlet velocity uniformity
- Inlet air density (if other than standard air)

Published for only one size, which shall be stated, at standard inlet air density:

- Velocity projection

The following statement shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

"The AMCA Certified Ratings Program seal applies to airflow rate, average outlet velocity, outlet velocity uniformity, velocity projection and power rating at free delivery only."

The manufacturer shall describe with the following statement the conditions under which the air curtain unit was tested and list the presence or absence of optional appurtenances available for arrangements that are cataloged but not included in the certified ratings. For example:

"Rated data shown are only for base (unheated) units, as shown."

The manufacturer may provide data that lists the effects on performance in the form of correction factors due to the presence of optional appurtenances available for arrangements that are cataloged but are not included in the AMCA Certified Ratings. It shall be described by the following statement, explaining that the performance obtained using these correction factors shall not be considered a certified rating but only an approximation.

“Performance data obtained from the correction factors shown herein are only an approximation and shall not be considered as part of the AMCA Certified Ratings.”

9.5 Rating method H: Jet fans

9.5.1 Calculated performance

Direct drive jet fans are rated at an as-run speed. The test fan performance may be used as the basis for calculating the performance of other fans sizes or speeds as permitted in accordance with ANSI/AMCA Standard 250 and ISO 13350.

9.5.2 Published data

The catalog data published under the AMCA Certified Ratings Program shall be determined in accordance with ANSI/AMCA Standard 250 and ISO 13350 and conform to the following requirements:

The performance rating for each model shall include:

- Nominal impeller speed
- Thrust
- Inlet air density (if other than standard air)

Choice of:

- Fan electrical input power or
- Fan impeller power

If volumetric airflow rate is published, it shall be calculated from thrust and gross outlet area in accordance with the following equation:

$$Q = \sqrt{\frac{A_2 T_c}{\rho_{std}}} \quad (\text{SI}) \quad \text{Eq. 9.1}$$

$$Q = 340.3 \sqrt{\frac{A_2 T_c}{\rho_{std}}} \quad (\text{IP}) \quad \text{Eq. 9.2}$$

If the model is also certified for FEI, the performance rating shall include the corresponding certified values.

The following statements shall be shown immediately adjacent to the ratings tables, graphs and/or charts:

“The AMCA Certified Ratings Program seal applies to thrust at free delivery only. Speed rpm] shown is nominal. Performance is based on actual speed of test.”

And:

“Performance ratings [include or do not include] the effects of appurtenances on the [inlet, outlet or inlet and outlet].”

When the effect of an appurtenance is included in the fan performance rating, the following statement shall be shown adjacent to the rating:

“Performance ratings include the effect of [list appurtenances (including silencers) here].”