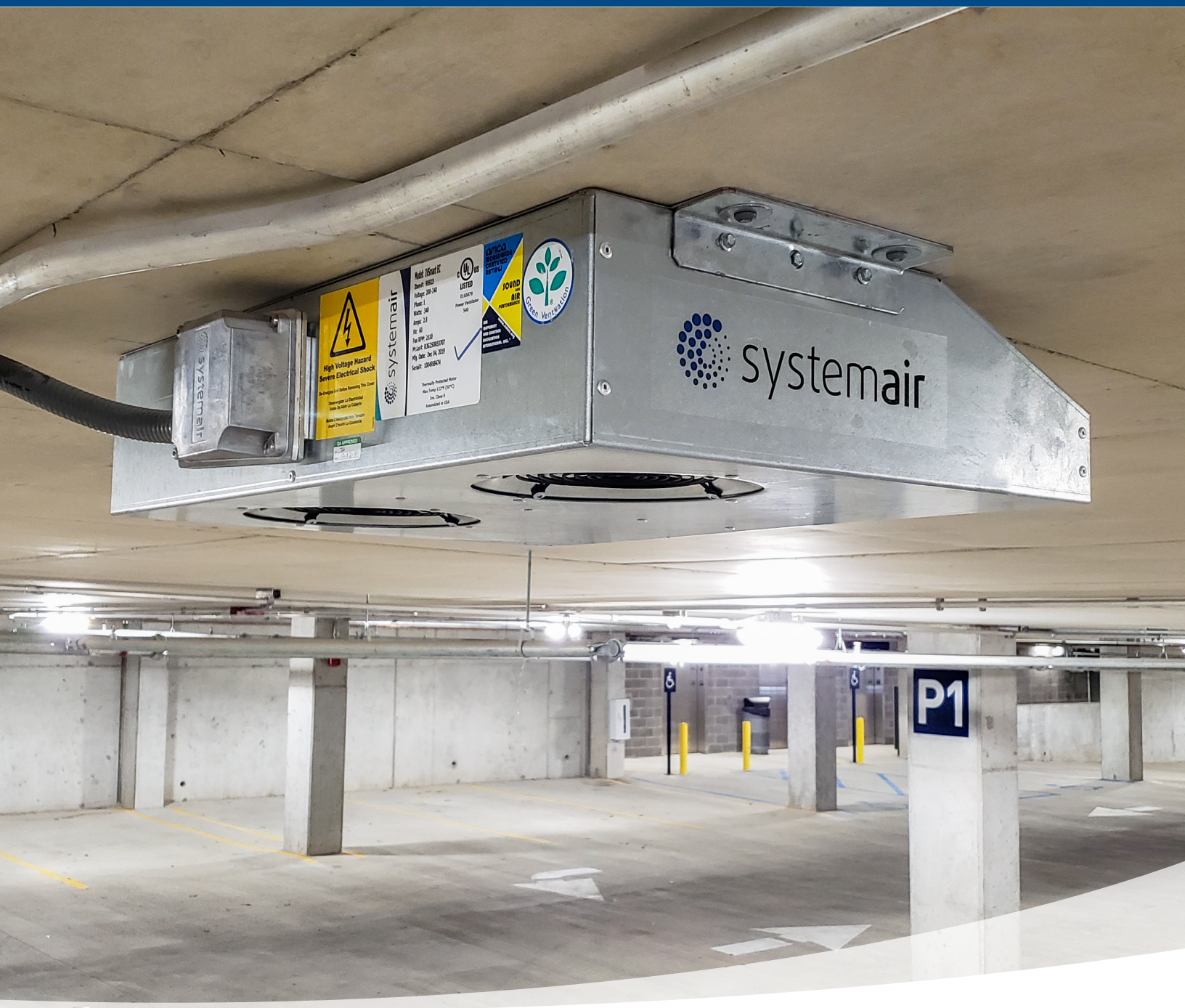
The AMCA 250 Standard

Updated standards for parking garage engineers and designers outlining the details within the newest revision of AMCA/ANSI Standard 250-22



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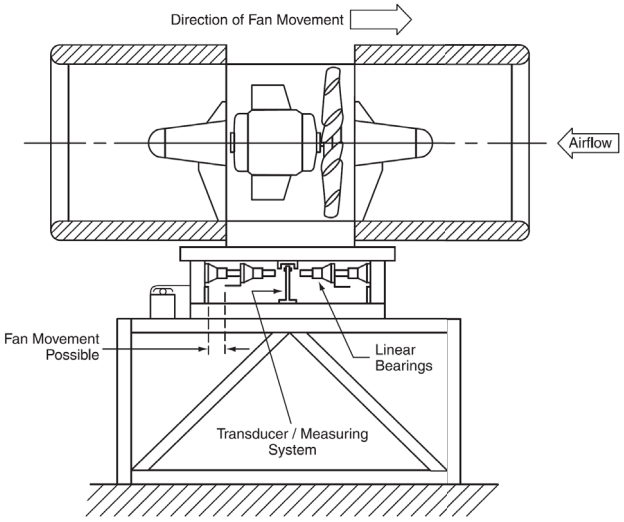
Jet Fan Key Performance Metrics

There are four key performance metrics regarding the overall performance of a jet fan. They are: ***Thrust, Airflow, Throw, Induction Factor***

Thrust

Commonly expressed as Newtons (N) or pound-force (lbf)

Thrust, a primary measurement of a jet fan, is the force exerted by the fan. Thrust is dependent on the outlet air velocity, shape, and direction. Thrust is obtained from laboratory testing in accordance with AMCA Standard 250.



ANSI/AMCA Standard 250, Fig. 4B, p. 25[1]

Airflow

Commonly expressed as Cubic Feet per Minute (CFM)

Airflow rate is the exact amount of air that moves through the fan housing. Airflow is calculated from equations provided in AMCA Standard 250.

$$Q = V_2 \times A_2 = \sqrt{\frac{Tm}{P_a A_2}} \times A_2 \qquad \text{SI}$$

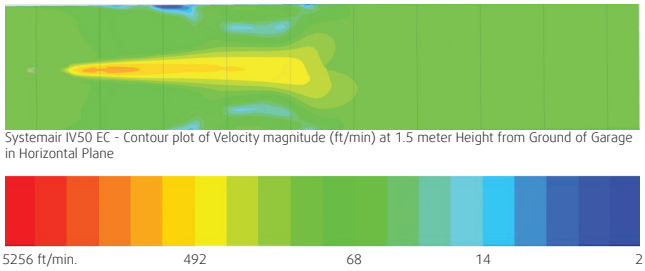
$$Q = V_2 \times A_2 = 340.3\sqrt{\frac{Tm}{P_a A_2}} \times A_2 \qquad \text{IP}$$

Legend (SI) [IP]:
Q = Volume Airflow (m^3/s) [cfm]
V_2 = Fan vibration velocity, reverse direction (m/s) [ft/min]
A_2 = Fan outlet area (m^2) [ft^2]
T_m = Measured thrust (N) [lbf]
P_a = Inlet ambient air density taken as equal to the air density in the test enclosure (kg/m^3) [lbm/ft^3]

Throw

Commonly expressed as feet (ft) or meters (m)

Throw length describes the farthest distance a jet fan can push air, specified by a terminal velocity of 1 m/s (196 fpm) at the end of the throw length. The longer the throw length, the more effective jet fans are in optimizing garage ventilation systems. Throw length is dependent on thrust, airflow, fan outlet shape, and airflow direction, and is generated from product-specific CFD analysis using AMCA 250 data. When comparing throw lengths of jet fans, make sure the same terminal velocity is used.



Systemair IV50 EC - Contour plot of Velocity magnitude (ft/min) at 1.5 meter Height from Ground of Garage in Horizontal Plane

Induction Factor

Calculated through AMCA 250 performance measurements

When air is thrusted forward through the outlet of a jet fan, high volumes of air surrounding the outlet are pulled with the discharged air. This process is called induction. Inducing airflow reduces 'dead spots' in a large, open space, like a parking garage. To quantify the induction of a jet fan, an induction factor equation is used. A higher induction factor means that a fan is better at entraining the stagnant surrounding air. The induction factor is generated from product-specific CFD analysis using AMCA 250 data.

$$IF = \frac{I}{Q}$$

$$I = V \times A$$

Legend (SI) [IP]:
IF = Induction Factor
I = Induced Airflow at the throw length (m^3/s) [cfm]
V = Average air velocity at the throw length (m/s) [ft/min]
A = Area of the positive velocity clip at the throw length (m^2) [ft^2]
Q = Airflow through the fan housing (m^3/s) [cfm]

Certified Performance Data of Jet Fans: Accuracy Leads to Safety

Before October 2018, AMCA allowed manufacturers to certify jet fan data with measured airflow methods. Then, AMCA released a new revision of AMCA Publication 211, *Certified Ratings Program Product Rating Manual for Fan Air Performance*, and as the press release stated,

"Following the October 2018 revision of AMCA Publication 211, jet fans no longer can be certified using ANSI/AMCA Standard 210/ASHRAE Standard 51 [Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating] and ISO 5801 [Industrial Fans — Performance Testing Using Standardized Airways] and must be certified using ANSI/AMCA Standard 250 [Laboratory Methods of Testing Jet Fans for Performance]."[2]

ANSI/AMCA Standard 210/ASHRAE Standard 51 and ISO 5801 provide methods to measure airflow, but not thrust. While measuring airflow is accurate for ducted products, this method does not consider the unducted application of jet fans. Jet fans produce an impulse of air that increases the momentum of air moving within a tunnel or parking garage space. This impulse of air, known as thrust, is difficult to predict with measured airflow. Furthermore, this high velocity of air entrains additional air volume around the fan's air discharge, and is quantified as the induction factor. ANSI/AMCA Standard 250, revised in 2022, specifically addresses the performance of jet fans by offering methods to measure the thrust a jet fan produces.

This paper clarifies why ANSI/AMCA Standard 250 (which will now be referred to as AMCA 250) is the most accurate 3rd party certification for testing thrust and airflow performance in jet fans. With trusted, certified data, designers can have confidence that their designs are not only accurate, but safe.

What Is the Goal of 3rd Party Certification?

The goal of certifying fan performance through a 3rd party is to eliminate any manufacturer bias from published fan performance. Eliminating manufacturer bias assures designers that a product's performance was verified with industry approved testing methods. These testing methods, provided by a 3rd party certification association like AMCA, are included in specifically-designed testing standards. These standards provide testing methods that can replicate many end applications. Therefore, when certifying fan performance with AMCA, manufacturers must certify their fan data using the AMCA test standard that most accurately replicates the end application of a product.

What Are the Key Metrics of a Jet Fan?

The key metrics of a jet fan include thrust, airflow, throw, and induction. Thrust measurements and airflow calculations, obtained from AMCA 250 testing, are the foundation of other key metrics designers seek when implementing a jet fan system. These other key metrics, such as throw and induction, are the result of Computational Fluid Dynamics (CFD) simulation. With accurate and certified AMCA 250 data, designers can trust CFD results to make confident choices and accurately predict jet fan performance for the end application.

Why Is Measuring Thrust Recommended Instead of Measuring Airflow?

Thrust represents the rate of change in momentum, and is a primary measurement of a jet fan. Jet fans are designed to be unducted, high-thrust products, meaning an ANSI/AMCA Standard 210/ ASHRAE Standard 51 airflow test chamber can not replicate the end application of a jet fan accurately. In addition, measuring airflow cannot provide the information needed to predict the induction produced by thrust.

AMCA 250 offers methods to measure airflow separately from the thrust measurement; however, these methods have the potential to alter fan operation, and varying results should be expected.[3]

Which AMCA Standards Provide the Most Accurate Methods to Simulate Jet Fan Performance?

The AMCA standards that best replicate the end application and eventual consumer experience are AMCA 250 and ANSI/AMCA Standard 300, *Reverberant Room Method for Sound Testing of Fans*. AMCA 250 provides testing methods to measure the thrust of a jet fan in a large test setup that is representative of a parking garage. ANSI/AMCA Standard 300 provides the methods to measure sound levels at the inlet, sound levels at the outlet, or the total sound power of the jet fan. For the best representation of a jet fan, testing the total sound power of a jet fan in a large test setup is most representative of a parking garage.

Manufacturers could still test jet fans to ANSI/AMCA Standard 210; however, AMCA will no longer certify a jet fan to ANSI/AMCA Standard 210/ASHRAE Standard 51 because the test method does not represent the end application, and ultimately, the methods provided within the standard alter the operation of a jet fan. AMCA 250 is specifically designed to test the performance of jet fans, meaning that the prescribed testing methods best represent an open parking garage in a lab environment.

So, What Do We Do With the Certified Data?

The certified data from AMCA allows jet fan manufacturers to assist designers in the development of their project.

A CFD analysis, using certified AMCA 250 data, will show the certified data in action, ensuring that the final ventilation system, optimized with jet fans will completely and effectively ventilate the space as intended.

With CFD simulation driven by certified data, designers have a valuable tool to assist them in the development of their project.

The Final Verdict

To conclude, AMCA has stated AMCA 250 must be used when certifying jet fan data. No other AMCA standard can provide accurate methods to measure the thrust and airflow of a jet fan. The corresponding certified performance data, through a 3rd party body like AMCA, ensures accurate and reputable data that represents real world applications. Since the initial data is backed by AMCA certification, designers can trust that the proposed ventilation system, optimized by jet fans, will ensure effective dilution and extraction of harmful gasses. Manufacturers that certify their jet fans to AMCA 250 equip designers with accurate information to confidently complete projects with safe and proper ventilation.

References

[1] Air Movement and Control Association International, INC. *Thrust Measuring Layout: Supported Method with linear Bearings and Transducer Measuring System.* "ANSI/AMCA Standard 250-22 - Laboratory Methods of Testing Jet Fans for Performance." AMCA. Figure 4B, 2022, P. 25.

[2] Air Movement and Control Association International, INC. "AMCA Testing Jet Fans per ANSI/AMCA Standard 250 Thrust Method." AMCA. Press Release, 12 Feb. 2020. https://www.amca.org/news/press-releases/amca-testing-jet-fans-per-ansi/amca-standard-250-thrust-method.html.

[3] Air Movement and Control Association International, INC. "ANSI/AMCA Standard 250-22 - Laboratory Methods of Testing Jet Fans for Performance." 5.1, 7.1. AMCA. 2022.

systemair

sales@systemair.net
www.systemair.net

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