Eurovent Industry Recommendation / Code of Good Practice

Eurovent 1/15 - 2026

Quality criteria for Fans and Fan units

First Edition

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Document history

This joint Eurovent and AMCA Industry Recommendation / Code of Good Practice supersedes all of its previous editions, which automatically become obsolete with the publication of this document.

Modifications

This publication was modified as against previous editions in the following manner:

Modifications as against	Key changes
1st edition	Current document

Preface

In a nutshell

This document provides comprehensive industry guidance on the quality criteria for fans and fan units, developed jointly by Eurovent and AMCA International. It serves as a practical reference for manufacturers, engineers, and stakeholders in the HVACR sector, especially in light of the new EU Regulation (EU) 2024/1834, as amended, effective 24 July 2026.

Authors

This document was published by Eurovent and European AMCA. It was prepared in a joint effort by participants of the Product Group 'Fan Technology' (PG-FANS) and European AMCA members, which together represent a vast majority of manufacturers of these products active on the EMEA market.

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Important remarks

Eurovent does not grant any certification based on this document. All certification-related issues are managed by the Eurovent's subunit Eurovent Certification. For more information, visit www.eurovent-certification.com.

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1 Introduction

These recommendations are based on extensive practical experience and long-term market observation by leading manufacturers and respected industry associations. All information provided reflects the latest standards and is accurate at the time of publication.

The purpose of this guidance is to support engineers in optimising energy efficiency, lowering operational costs, and minimising environmental impact. It also aims to assist in selecting the most suitable fan units from a wide range of options tailored to diverse applications and operating environments.

By following these recommendations, professionals can ensure the selection and installation of fan systems that deliver high performance and efficiency, ultimately resulting in better outcomes for clients and more sustainable solutions overall.

1.1 Stand-alone and new embedded fans

In the fan manufacturing industry, the basic structure of a fan is typically defined by three core components:

- **Stator**: The non-rotating elements within the airstream that help guide airflow and contribute to pressure increase.
- **Rotor**: The rotating aerodynamic component responsible for moving air. Rotors are further classified based on airflow direction, **radial** or **axial**.
- **Motor**: The electrical drive unit that powers the rotor, determining the fan's energy input and operational characteristics.

This definition aligns with EN 17166, Clause 5.3, which outlines the significant elements of fan construction.

1.2 Fan Categories and Examples

The market offers a wide range of fan categories, each suited to specific applications and performance requirements. To ensure consistency and regulatory compliance, fan classifications should align with terminology used in EU Regulation (EU) 2024/1834, as amended and AMCA Standard 214:

Article 2 of Regulation (EU) 2024/1834	AMCA 214 Classification
Axial Fans	Axial Inline, Axial Panel, Axial Power Roof Ventilator
Centrifugal Fans	Centrifugal Housed, Centrifugal Unhoused, Centrifugal Inline
Mixed Flow Fans	Mixed Flow Fans
Forward Curved Fans	Centrifugal Inline Fans
Backward Curved/Inclined Fans	Centrifugal Unhoused Fans
Crossflow Fans	Crossflow Fans (excluded from AMCA 214 scope)
Jet Fans	Jet Fans
	Centrifugal Power Roof Ventilator – Exhaust / Supply
	Centrifugal Inline, Axial Inline

Table 1: Common Fan Categories (EU & AMCA Terminology)

These fans may be direct-driven or equipped with a motor and transmission system (e.g., belt or gear drive). For optimal aerodynamic efficiency, centrifugal fans with backward curved blades are generally preferred.

Blade Design Classification (Based on β_2 Angle)

The centrifugal blade angle (β_2) is defined as the angle between the tangent to the outer circumference at the trailing edge and a bisecting line through the blade's trailing edge. For blades with rapidly changing geometry, β_2 is calculated as the arithmetic mean over 50% of the trailing length.

Blade type	Angle Range (β_2)
Backward Curved	$0° < \beta_2 \leq 50°$
Backward Inclined	$50° < \beta_2 \leq 90°$
Forward Curved	$\beta_2 > 90°$

Table 2. Blade design classification based on β_2

These classifications are referenced both in Regulation (EU) 2024/1834, as amended and AMCA 214 and are essential for understanding fan performance characteristics, especially in relation to efficiency, noise, and pressure capabilities.

Fan Units and Application-Specific Types

As per EN 17166 Clause 5.3, fan units are defined as complete assemblies intended for a specific purpose. Examples include:

- Roof Fans
- Box and Ducts Fans
- Inline Duct Fans
- Centrifugal Fans
- Other specialized types not covered by Regulation (EU) 2024/1834.

Figure 1. Examples of axial fans. ©Ziehl-Abegg (right)

This definition aligns with EN 17166, Clause 5.3, which outlines the significant elements of fan construction.

2 Energy Efficiency

Fan efficiency is a critical factor in reducing energy consumption and operational costs. While Regulation (EU) 327/2011 originally defined minimum efficiency requirements at the Best Efficiency Point (BEP), the updated Regulation (EU) 2024/1834, as amended, effective 24 July 2026, significantly raises these standards to reflect technological advancements and sustainability goals.

The regulation now mandates that efficiency be assessed across the entire fan system, including the motor, aerodynamics, and auxiliary components and introduces, starting from 24 July 2027, part-load performance as a legally binding criterion. This ensures that fans operate efficiently not only at peak performance but also under varying load conditions throughout their lifecycle.

2.1 Updated Ecodesign Minimum Electrical Efficiency Grades

The minimum efficiency ($\eta_{\_min}$) is calculated using the formula:

$\eta_{\_min} = 4.56 \cdot \ln(P_e) - 10.5 + N$

Where:

P_e - electric input power in kW

N - efficiency grade (varies by fan type)

Fan Type	Min Efficiency Grade (N)	Recommended Efficiency (%) for static pressure
Axial Fans	50	55 – 75%
Forward Curved (<5 kW, direct)	52	55%
Other Centrifugal Fans	64	70 – 75%
Mixed Flow Fans	57	60%
Jet Fans	50[1]	55%

Table 3: Updated ecodesign Minimum Electrical Efficiency Grades

Note: The minimum efficiency requirements outlined in Regulation (EU) 2024/1834, as amended, will become legally binding as of 24 July 2026. For projects planned well in advance, it is strongly recommended to consult with manufacturers to ensure that their products can meet or exceed these thresholds.

Importantly, the regulation now mandates consideration of efficiency not only at the Best Efficiency Point (BEP) but also under part-load conditions, which are now part of the mandatory Ecodesign criteria. This ensures that fans deliver optimal energy performance across a range of operating conditions and supports compliance with extended information and transparency obligations.

Furthermore, to qualify for incentive programs aimed at replacing or upgrading to more energy-efficient units, the fan's efficiency must exceed the minimum regulatory requirements. Higher efficiency translates directly into greater energy savings and long-term cost reductions.

[1] Jet fans follow a different measurement category

Figure 2. Example of fan types. Upper left: centrifugal fan (© AQ International BV); Upper right: centrifugal Fan - fan array arrangement (© Ziehl-Abegg), Lower left: plug fan with all significant elements (© ebm-papst); Lower right: motorised impeller (© ebm-papst)

3 Performance Characteristics

Fan selection is typically based on performance curves generated from test bench data, often accessed through specialised selection software. For larger fans that exceed the capacity of standard test benches, Recommendation 1/14 on the performance tests of very large axial fans[2] may be used to estimate performance.

Measurements on test benches are conducted under idealised conditions, such as undisturbed airflow, optimal setup, and standardised reference values commonly based on standard air density of 1.2 kg/m³ at 20°C.

3.1 AMCA Standard

AMCA 210: Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

[2] Eurovent 1/14 – 2025 'Performance tests of very large axial fans in the context of Ecodesign requirements' (https://www.eurovent.eu/publications/eurovent-1-14-performance-tests-of-very-large-axial-fans/

This standard defines uniform laboratory procedures for determining the **aerodynamic performance of fans**, including airflow rate, pressure development, power consumption, and efficiency. It provides controlled test methods used to generate **certified and comparable performance ratings**, ensuring that fan characteristics such as flow and pressure are measured accurately and consistently across different laboratories and applications.

3.2 ISO Standards

- **ISO 5801** – *Fans - Performance testing using standardized flow test rigs*
  This standard defines procedures for measuring key performance parameters including flow rate, pressure, and efficiency. It ensures that fans are tested under consistent and reproducible conditions, enabling reliable comparisons across products and manufacturers.
- **EN ISO 5167** – *Measurement of fluid flow in closed conduits*
  This standard covers techniques for measuring airflow using devices such as orifice plates, nozzles, and Venturi tubes, which are often integrated into fan test rigs.
- **EN ISO 14694** – *Industrial fans - Specifications for balance quality and vibration levels*
  While primarily focused on mechanical vibrations, this standard is also relevant to performance evaluation, particularly in terms of operational stability and long-term reliability.

Together, these standards form the foundation for design, testing, and quality assurance in the industrial fan sector. ISO 5801 remains the central reference for performance testing, while the others address specific aspects such as flow measurement and vibration analysis (discussed further in the vibration section).

AMCA 210 are often compared with ISO 5801. Both standards measure total, static, and dynamic pressure, and while their definitions are broadly comparable, they are not entirely identical. The main differences are that AMCA relies partly on different reference points for pressure measurement, whereas ISO 5801 specifies stricter requirements for calibration and the evaluation of measurement uncertainty.

4 Test Rigs and Bench Setup

To ensure accurate and reliable fan performance measurements, test rigs must be constructed in accordance with established standards. ISO 5801 serves as the primary reference, outlining the fundamental requirements for fan testing setups.

Many manufacturers also integrate their laboratory environments and procedures into a broader quality management system, typically aligned with ISO 9001. This ensures consistency, traceability, and compliance across all testing activities.

Key aspects defined by ISO 5801 include:

- **Duct Design and Flow Conditioning**
  The standard specifies how the **inlet and outlet sections** of the test rig must be configured to ensure uniform airflow. This includes requirements for **duct diameter**, **length of straight sections**, and methods to achieve **flow stability and uniformity**.
- **Pressure Measurement**
  ISO 5801 defines the **location and accuracy** of pressure measurement points to ensure that recorded values accurately reflect the fan's operating conditions.
- **Volume Flow Measurement**
  The standard outlines acceptable methods for determining **air volume flow**, such as using **orifice plates**, **Venturi tubes**, or other calibrated flow devices. It also specifies how these instruments should be integrated into the test setup.

- **Instrumentation Layout**
  Proper arrangement of sensors for **pressure, temperature, humidity**, and **volume flow** is essential. The standard provides guidance to ensure all relevant parameters are captured correctly and consistently.
- **Calibration and Uncertainty**
  ISO 5801 includes requirements for the **calibration of measurement equipment** and the **evaluation of measurement uncertainties**, both of which are critical for producing valid and comparable results.

In summary, a test bench must be designed and operated in full compliance with **ISO 5801** to ensure that performance data is both accurate and comparable across different manufacturers and testing facilities.

4.1 Installation Types for Measurement

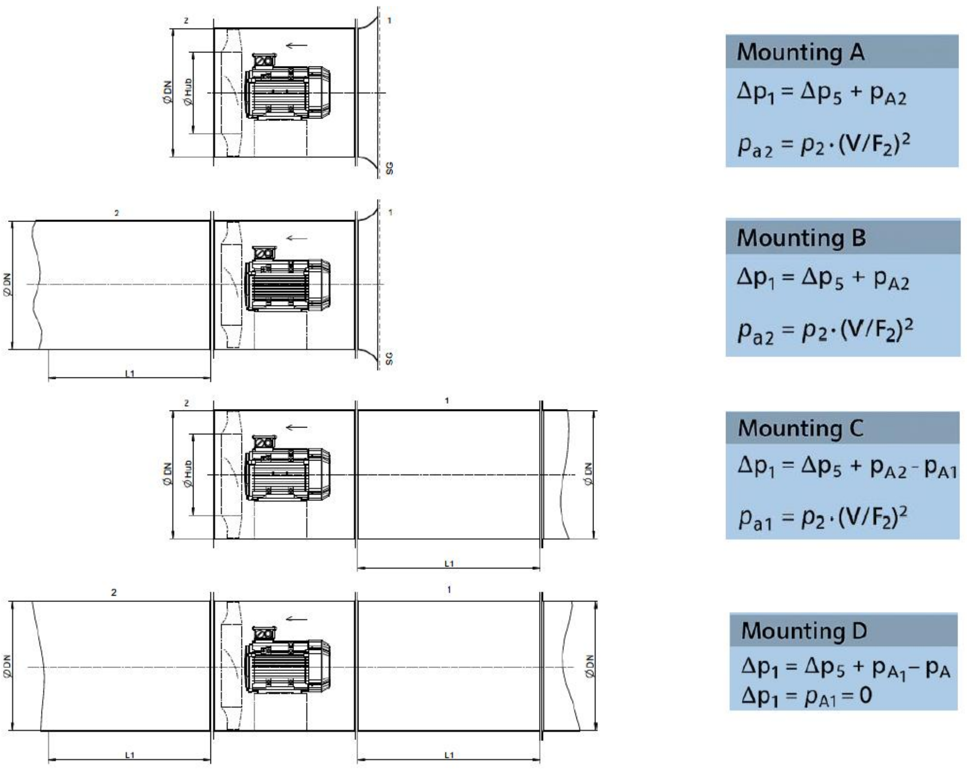

Figure 3. Installation types of fans according to ISO 5801

Figure 4. Duct test rig ISO 5801 ©Systemair

Figure 5. Chamber test rig AMCA 210 ©Systemair

4.2 Credibility of declared performance

To ensure the accuracy and reliability of performance data, many manufacturers choose to **accredit their test benches** through recognized certification bodies. In Europe, **RLT accreditation**, often associated with reputable organizations such as **TÜV** and **AMCA accreditation** are among the most widely accepted.

Manufacturers may also register their performance data through official **fan certification programs**, the most prominent being the **AMCA Certified Ratings Program (CRP)**. This third-party certification process ensures full transparency, as all certified data is publicly accessible via the AMCA website[3].

In addition, the Eurovent Certified Performance (ECP) programme provides a complementary certification framework in Europe for fans used as components in Air Handling Units (AHUs). The programme is based on AMCA 211 rating standards and is operated in cooperation with AMCA International. It combines AMCA evaluation protocols with independent Eurovent certification audits, thereby adding an extra layer of verification. As a result, products must first obtain AMCA certification before they can qualify for the Eurovent Certified Performance mark. Fans bearing the Eurovent Certified Performance mark and their certified data are available on the publicly accessible Eurovent website[4].

It's important to note, however, that **certification does not guarantee high efficiency**. Certification simply verifies that the **published performance data accurately reflects the actual performance** of the fan under standardized testing conditions. While this builds trust and comparability in the market, efficiency must still be evaluated based on application-specific requirements and system integration

5 Acoustic Performance

Accurately determining and evaluating the sound performance of industrial fans requires adherence to specific standards and measurement techniques. Among the most important are those developed by AMCA (Air Movement and Control Association) and relevant ISO standards, which provide internationally recognized methodologies for fan noise assessment.

5.1 AMCA Standards

AMCA 300-24[5]: *Reverberant Room Method for Sound Testing of Fans*
This standard outlines procedures for measuring fan noise in a **reverberation room**, a controlled environment designed to capture sound reflections. The method enables precise calculation of the fan's **sound power levels** across various frequency bands, which is essential for understanding noise characteristics and performance.

AMCA 301[6] *Methods for Calculating Fan Sound Ratings from Laboratory Test Data*
This standard complements AMCA 300-24 by detailing how to process and standardize the measurement data. It provides guidance on calculating and presenting **sound power ratings**, allowing for consistent comparison between different fan models and manufacturers.

AMCA Standard 320 – *Laboratory Method of Sound Testing of Fans Using Sound Intensity*.
This standard provides an alternative method for determining sound power using sound intensity techniques.

[3] https://www.amca.org/certify/
[4] https://www.eurovent-certification.com/en/third-party-certification/certification-programmes/fans
[5] https://www.amca.org/publish/publications-and-standards/amca-standards/amca-standard-300-24-reverberant-room-methods-of-sound-testing-of-fans.html
[6] https://www.amca.org/publish/publications-and-standards/amca-standards/amca-standard-301-14-methods-for-calculating-fan-sound-ratings-from-laboratory-test-data.html

Together, these standards ensure that fan noise is measured and reported in a reliable, repeatable manner, supporting informed decision-making in system design and product selection.

5.2 ISO standards

Various ISO standards must be considered when measuring fan noise:

These include **ISO 3741**[7] (Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test rooms) This standard is the internationally equivalent method to **AMCA 300-24** and describes how sound power levels are measured in reverberation rooms.

ISO 13347[8] (Determination of fan sound power levels under standardized laboratory conditions) is another supplementary standard to the previously mentioned standard.

This standard comprises several parts specifically designed for fans and specifies detailed procedures for determining their noise generation.

ISO 9614[9] (Determination of sound power levels of noise sources using sound intensity). This method is less commonly used by manufacturers but should still be mentioned.

ISO 5136 – *Acoustics — Determination of sound power radiated into a duct by fans*.
This in-duct acoustic test method is particularly relevant for fans operating within duct systems.

Measurement method for fan noise - explanation of terms

Sound power level: This parameter indicates the total sound energy emitted by a sound source and is measured in decibels (dB). Measurements are often carried out in frequency bands to identify frequencies with high noise levels.

Reverberation Room: A specialized room with reflective surfaces used to accurately determine sound power.

Airflow Conditions: Noise levels depend on operating conditions, so fans are measured under defined airflow scenarios.

Installation: The installation method (e.g., ducted, open) can influence noise measurements. Fans installed in the field may produce inherent noise not captured in laboratory tests, especially in unfavorable positions.

Fans installed in the field or during final assembly often cause inherent noise that the laboratory cannot record. This includes particularly unfavorable installation positions, etc.

Sound information in technical data sheets

Most manufacturers specify fan noise in the form of sound power levels, often broken down by frequency bands as defined in AMCA and ISO standards. It is important to distinguish between:

Sound Power: Represents the noise emission of a source, independent of location.

Sound Pressure: Varies with distance and environment and is not a reliable indicator of source noise beyond approximately 100 meters due to ambient influences like reflections and background noise (source: Fraunhofer Institute reports).

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[7] https://www.iso.org/standard/52053.html
[8] https://www.iso.org/standard/29753.html
[9] https://www.iso.org/standard/24012.html

6 Vibration Analysis

In general, the quality of a fan also depends on the so-called vibrations. It is particularly important to pay attention to the following criteria and standard specifications for balancing quality in the manufacturer's documentation.

ISO 21940-11:2016 – *Mechanical vibration — Rotor balancing*.
Defines balancing grades for rotating machinery.

ISO 14964:2003 – Specifies recommended balancing grades for fans up to 300 kW.

ISO 10816:2009 – Provides recommended balancing grades for fans with driving motors exceeding 300 kW, typically heavy-duty industrial fans.

ISO 10816-3 – Applies to fans and sets vibration limits for machines with nominal power above 15 kW.

ISO 14694:2003-03 – Specifies limits for vibrations both on delivery and for fans already installed. It also describes the positions and settings for vibration measurements and emphasizes the importance of post-installation checks for abnormal vibrations.

ISO 4964 – Defines the criteria for rigid installation, which affects permissible vibration levels.

AMCA 204 – *Balance Quality and Vibration Levels for Fans*.
This standard provides guidelines for acceptable vibration levels based on fan type, size, and installation method. It distinguishes between rigid and flexible installations and helps manufacturers and users ensure compliance with vibration performance expectations.

Reduced lifetime due to strong vibrations

Two cases must be considered:

- **Motor Bearings**: Increased vibrations and shocks can significantly reduce the service life of motor bearings.
- **Component Fatigue**: Vibrations caused by system component excitations can lead to premature fatigue, especially in impellers, potentially resulting in breakdowns.

Manufacturers of accessories often provide selection tools to calculate parameters such as the center of gravity or to identify harmful resonance fields that may cause higher vibrations, especially under speed regulation.

Important: It is always mandatory to check fans for abnormal vibrations. Qualified fan manufacturers typically provide checklists for this purpose, and measurements should be carried out using appropriate equipment.

Figure 6. Different versions of typical vibration damper. Source: publicly available materials

7 Mechanical Design Considerations

In many applications, fans and products such as air conditioning units, cooling towers and heat pumps are installed outdoors, either mounted on building exteriors or rooftop surfaces, exposing them to year-round weather conditions. Environmental factors such as temperature fluctuations and precipitation can significantly reduce the operational lifespan and performance quality of these units.

To ensure durability and reliability, **weatherproof construction** is essential. Manufacturers must also account for the increasing impact of climate change. For example, heavy rainfall events exceeding **200 liters per hour** are becoming more common in Central Europe, and fan designs must be robust enough to withstand such conditions.

A critical aspect of outdoor durability is **corrosion resistance**. The relevant standard in this context is:

EN ISO 12944 – *Paints and varnishes — Corrosion protection of steel structures by protective paint systems*.
This standard classifies environments into **corrosivity categories** based on exposure to atmospheric or chemical stress, helping determine suitable protective measures:

- **C1**: Very low corrosivity (e.g., climate-controlled indoor areas)
- **C2**: Low corrosivity (e.g., rural outdoor areas with low pollution)
- **C3**: Medium corrosivity (e.g., urban and industrial areas with moderate pollution)
- **C4**: High corrosivity (e.g., industrial and coastal environments)
- **C5-I / C5-M**: Very high corrosivity
    - **C5-I**: Industrial zones with high humidity and aggressive atmospheres
    - **C5-M**: Coastal and offshore areas

For most HVAC applications, fans should be verified to meet **C3 or C4** requirements. Many manufacturers offer solutions suitable for even more demanding environments, including those with elevated pollutant levels.

Additionally, the **AMCA 204** standard should be considered in mechanical design:

AMCA 204 *– Balance Quality and Vibration Levels for Fans.*
This standard outline acceptable vibration levels based on fan type, size, and installation method, contributing to mechanical integrity and long-term reliability.

8 Conclusion

This document has outlined the relevant standards and methodologies for obtaining fan performance data under optimal laboratory conditions. However, it is well understood that fans installed within products such as air handling units (AHUs) rarely operate under such ideal circumstances. Various system effects arising from the fan's mounting position and surrounding geometry can significantly impact performance.

Key considerations include:

- **Space Requirements:** Adequate clearance in the suction and exhaust areas is essential. Restricted space can lead to turbulence, reducing efficiency and increasing noise.
- **Airflow Disturbances:** Sharp bends in the airstream upstream or downstream of the fan can cause turbulence. These effects should be minimized through thoughtful design of the product in which the fan is integrated.

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- **Drive Mechanisms:** Belt drives and gear systems consume additional power. Direct-driven fans are generally preferred for higher efficiency and lower maintenance.
- **Fan Type and Placement:** When a fan is positioned directly upstream of a duct, using a scroll housing or even an axial fan may be beneficial. This setup can help utilize dynamic pressure and reduce losses.
- **Motor Efficiency:** High-efficiency motors are crucial. For asynchronous motors, IE4 efficiency grade is recommended. Permanent Magnet (PM) or Electronically Commutated (EC) motors offer even better performance.
- **Variable Speed Drives (VSDs):** These should be included as standard, since operating conditions may vary over time. Speed adjustment via VSDs can lead to significant energy savings.

Ultimately, real-world fan performance depends not only on the fan itself but also on how it is integrated into the system. Considering these factors during design and installation ensures better efficiency, lower noise, and longer equipment life.

About Eurovent

Eurovent is the voice of the European HVACR industry, representing over 100 companies directly and more than 1.000 indirectly through our 16 national associations. The majority are small and medium-sized companies that manufacture indoor climate, process cooling, and cold chain technologies across more than 350 manufacturing sites in Europe. They generate a combined annual turnover of more than 30 billion EUR and employ over 150.000 Europeans in good quality tech jobs.

Mission

Eurovent's mission is to bring together HVACR technology providers to collaborate with policymakers and other stakeholders towards conditions that foster fair competition, innovation, and sustainable growth for the European HVACR industry.

Vision

Eurovent's vision is an innovative and competitive European HVACR industry that enables sustainable development in Europe and globally, which works for people, businesses, and the environment.

→ For in-depth information and a list of all our members, visit www.eurovent.eu

About AMCA

AMCA is a not-for-profit association of manufacturers of fans, louvres, dampers, air curtains, airflow-measurement devices, ducts, acoustic attenuators, and other air-system components. AMCA is a truly global association with operations in Europe (Brussels), Asia, North America, the Middle East, and Latin America, and nearly 400 member companies. AMCA provides global services for verification of compliance, development of standards, and advocacy for model codes, regulations, and utility incentive programs promoting efficiency and life safety.

→ For more information, visit www.amca.org