

Minimizing Risk Through Proper Axial Fan Selection

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Introduction

Selecting an axial fan is easy, right? You only need to know the performance point, sound requirements, and size restrictions. The only thing left is to require certifications in order to assure those criteria are met. Unfortunately, it is not so easy.

Subtleties in the catalogs, certifications and performance of axial fans, combined with a relatively high number of corresponding certifications and standards, make it easy to select the wrong fan or incorrectly compare two performance points.

Improper fan selection and procurement leads to increased cost and project delays due to higher commissioning, expensive returns and inefficient operation.

Read on to better understand the following:

- Relevant certifications,
- High temperature certifications and derating (EN12101-3 and UL),
- Challenges of completing a “full-product” certification,
- Common pitfalls.

Relevant Certifications

Air and Sound Certification — AMCA

The most important part of the fan is its air and sound performance. Improper airflow or higher than expected sound

levels can lead to costly project delays and must be avoided, whenever possible. AMCA offers solutions to such problems by offering the AMCA Certified Ratings Program (AMCA CRP). AMCA CRP serves as the global standard in air and sound performance testing. A brief introduction of the axial fan related AMCA certifications will be provided and additional information can be found in the references at the end.

The AMCA CRP program has two sets of documentation: publications and test standards. Publications are high-level descriptions defining the steps required for a product series to be certified. The publications then reference specific test standards which further define test procedures.

About the Author

Troy Goldshmidt has 15 years' experience in the HVAC industry, most recently with Greenheck Fan Corporation as the International Product Manager. He leads the global market research to define, analyze and manage products across their life-cycle. He also creates system offerings for smoke and fire applications including car park ventilation and building pressurization. He has designed and sold systems in regions such as South America, Mexico, Latin America, India, and the Middle East. He previously worked for Johnson Controls as a principal engineer. He received his BS and MS in electrical engineering from University of Wisconsin-Madison, and later received his MBA from University of Wisconsin-Milwaukee.

The two main publications for axial fans are:

- AMCA Publication 211, *Fan Air Performance*
- AMCA Publication 311, *Fan Sound Performance*

The AMCA CRP test standards are shown under Test Standards in this document. A specifying engineer or consultant may choose to reference both the publication and the test standard in order to increase their confidence that the product is AMCA certified.

Test Standards

- ANSI / AMCA Standard 210, *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*
- ANSI / AMCA Standard 250, *Laboratory Methods of Testing Jet Tunnel Fans for Performance*
- ANSI / AMCA Standard 300, *Reverberant Room Method for Sound Testing of Fans*
- ISO 5801, *Industrial Fans — Performance Testing Using Standardized Airways*
- ANSI / AMCA Standard 320, *Laboratory Methods of Sound Testing of Fans using Sound Intensity*
- ANSI/AMCA Standard 205, *Energy Efficiency Classification for Fans*

In order for a product to qualify as an AMCA Certified Product, it must meet all of the following criteria:

- Tested at AMCA Accredited laboratory
- Tested to the appropriate test standard
- Published catalog or electronic selection software that is reviewed and approved by AMCA
- All certified models are listed at www.amca.org with a reference to the certified catalog and/or electronic selection software
- Periodic check test performed on schedule.

If any of the above criteria are not met, the product is not certified and should not bear the AMCA seal. An uncertified product could lead to low performing air and sound, and costly commissioning.

AMCA is a third-party, independent entity that verifies air and sound performance and ensures that all manufacturers use the same methods for collecting the data. When comparing fan performance between manufacturers, it is critical that you compare AMCA data to AMCA data. If a manufacturer's data is not AMCA certified, it may not be independently verified.

High Temperature Certifications

Similar to the air and sound performance, the motor make and origin selected for the high temperature application should exactly match the tested combination of fans and motors. A manufacturer loses the certification and assurance that the fan will perform if they use a motor from a different country or different brand name.

Common certifications are the following:

- UL Power Ventilators for Smoke Control Systems: 572°F/2 hours, 752°F/2 hours
- EN12101-3 Specification for Powered Smoke and Heat Exhaust Ventilators: 300°C for two hours, 400°C for two hours.

EN12101-3 is a European-based standard which certifies ventilators to be used for smoke control applications. It requires that the units be fully immersed in the hot air as opposed to just the air flow through the prop. In addition, the worst case conditions must be tested along with all accessories. The high temperature testing also must occur in the proper mounting position or else the certification is invalid. Matching the EN12101-3 requires being tested by a third party company which is an official notified body. The manufacturer can then display the CE mark.

UL requires that one fan size be tested to qualify a specific motor manufacturer. The test process, as well as the motor size and power, is defined and chosen by the manufacturer and subsequently confirmed by the UL inspector. Any test temperature and duration is selected by the manufacturer because UL does not have a test standard. The time and temperature is typically selected based on other standards or codes such as NFPA and IBC. However, the time, temperature, and test methodology can vary from company to company and even across product lines within the same company.

In the case of both UL and EN12101-3, if the fan is installed or configured in a way that is different from the way it was tested and certified, then it is no longer certified to work in the intended high temperature environment.

High Temperature – Derating Performance

A high temperature rated fan is less efficient than a standard temperature fan. This is primarily because as the temperature of the fan increases, the blade and the housing have different rates of thermal expansion. In order to prevent the blades of the fan from touching the fan housing, the distance between the blades and fan housing (tip clearance) must be increased. Depending on the performance point, the difference in efficiency could result in 1-10% difference in power consumption, and in some cases may also require a larger motor.

There is no standard method for derating the high temperature performance to the standard fan performance. However, if you encounter a manufacturer that has the same performance for the standard and high temperature fans, it is strongly suggested that you ask the manufacturer why there are no performance degradations published.

Challenges of Completing A 'Full-Product' Certification

With advances in manufacturing processes of axial fans, each product has a high degree of configuration which makes certifying the product difficult, and making sure the product you are selecting is certified equally difficult. *Review the certification documents to ensure the model being purchased matches the model offered.*

The standard design components of an axial fan are:

- Fan size diameter
- Hub diameter
- Number of blades
- Pitch angle of blades.

Every performance point must be certified across all of these

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construction combinations which typically requires that a high number of fans be tested. AMCA allows propellers to be tested with blades at various degree increments. That initial data can then be used to interpolate the performance across the other points which have not been tested. Accessory losses can also be subtracted from the AMCA certified data. However, only the base unit data is actually AMCA certified and published because the fan performance will be maximized.

As an example, please refer to Greenheck's RA product line. This product has the entire product line certified to bear the AMCA Air and Sound seal.

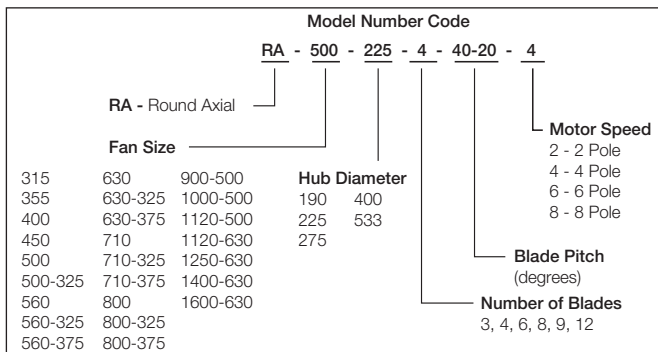


Figure 1: RA fan model nomenclature

Figure 1 shows the breakdown of the RA model nomenclature and all the potential combinations. It is a significant cost to test the product across all the various combinations, which is motivation for the manufacturers to be tempted to not validate the entire line.

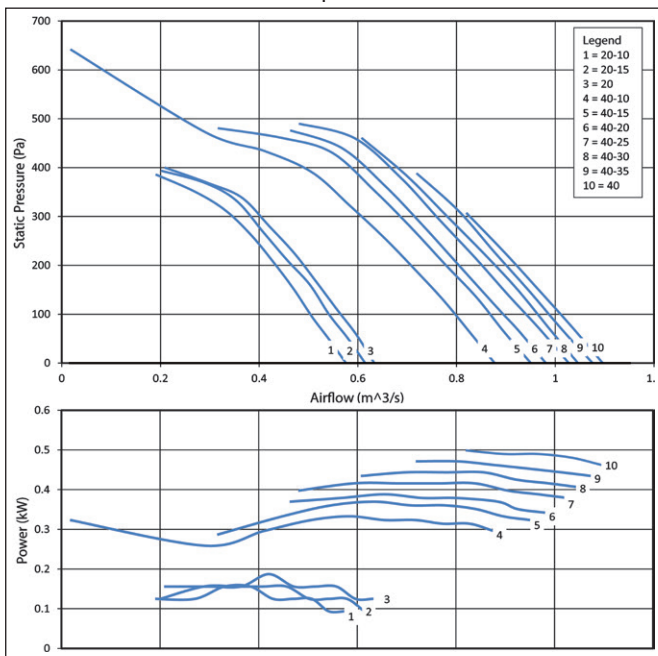


Figure 2: This excerpt from RA fan catalog performance catalog shows certified data for the 315 mm diameter fan with a 225 mm hub. The fan certified has three blades and was tested at ten different blade angles.

To further illustrate, Figure 2 shows an excerpt from the AMCA certified performance catalog showing various pitch angles on a single fan size, hub, prop, and motor speed combination. These

catalogs are required to be available on the AMCA website. In order for the RA product line to be completely certified, over 1,000 tests (air and sound) were submitted to AMCA. These tests accounted for all the data shown in the Model RA performance catalog, as well as in the Computer Aided Product Selection program, CAPS. Each RA model was tested across ten different blade angles that performed within close enough performance of each other to guarantee the required AMCA tolerance. This method of rating provides a rigorous and thorough process to ensure that the test data provided will match what manufacturers actually produce for all fan sizes and construction combinations.

To ensure you are getting a certified product, it is vital to confirm that the construction details of the fan selected match the certified product. This requires confirming the fan diameter, blade size, hub size, number of blades and the pitch angle. If a competitor does not submit the full product code, it is important to request it and verify that model is certified.

Common Pitfalls

Tested "In Accordance With"

Many manufacturers claim that a product is tested "in accordance with" a particular standard. The standard could be AMCA, UL, EN or any other standard, but "testing in accordance with" does not mean that the product is certified. For example, when a manufacturer requires the EN12101-3 certification, the testing must be conducted by a "notified body" that is a third party testing facility who ensures the product works in the desired environment. If a manufacturer claims to have EN12101-3 and they have not employed the services of a notified body or cannot direct the customer to a notified body's website, then the product is not certified. Without third party certification, there is no assurance that the products purchased will perform in an emergency situation when the customer needs it the most.

Similarly, a product could be tested to a particular AMCA standard, but it may only be tested by the manufacturer on uncertified equipment. The manufacturer may then potentially test limited product variations that are not representative of the worst case conditions. AMCA may have not been involved in the testing, nor in reviewing the data, yet the manufacturer could still claim to be tested "in accordance with" that particular standard.

Regardless of the standard, it is important to minimize risk and maximize safety by confirming that the products being purchased are properly certified.

AMCA Certified Ratings Seal Versus Member Logo



MEMBER

AMCA member logo



AMCA certified rating

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Another important point to note is the difference between the AMCA certified ratings seal and the member logo. The member logo can be used on marketing documentation that has no performance data in order to demonstrate that the company is a member of the AMCA organization. It does indicate any certification for a particular product line. Sometimes companies may place the member logo on documentation with performance data. This misleads the audience to think that the product is AMCA certified. The confusion that this misuse can cause is why it is a violation of AMCA.

The AMCA ratings seal, on the other hand, is used to show that a particular product is certified to air and/or sound.

Catalog Comparison Tips — Sound Comparisons

With axial fans in particular, the sound data can be confusing. Manufacturers may choose to publish sound power or sound pressure. Sound power is easier to compare because it is not affected by the environment or distance. Sound pressure, on the other hand, will give different results depending on the environment. If comparing sound pressure levels, make sure to pay attention to the type of sound that is tested (inlet/outlet/total sound) along with any distance references of published dBA ratings. It is also important to be aware of what type of sound information is published and certified. The sound performance could be listed as octave band sound power levels, A-weighted sound power levels or sones (either hemispherical or spherical). When comparing the sound levels of two fans, review their respective method of testing and confirm that the results are comparable. Similarly, make sure that when comparing sound on products, the product is also AMCA Air and Sound Certified.

Conclusion

The elements outlined in this paper are critical to ensuring you get the product and performance that you can rely on. Understanding ways to properly select an axial fan and determining that it is certified will minimize the risk of surprises occurring on the job site. This will prevent costly project delays due to extended commissioning, product returns and potential reorders from another supplier — saving time and money. In the case of smoke removal or other safety applications it is vital to ensure the health and safety of the building occupants. Specify, purchase and install with confidence — correctly select certified products for your building projects.

Sources

- AMCA Publication 11, *Certified Ratings Program Operating Manual*
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