

PRODUCT APPLICATION GUIDE

A technical bulletin for engineers, contractors and students in the air movement and control industry.

Understanding the Development of Fan Sound Data and the Product Rating Process

Sound is a very important consideration in the selection and application of fans. If not properly evaluated, fan sound can turn an otherwise completely acceptable application into a disaster. In spite of this, fan sound continues to be one of the most misunderstood topics in the air handling industry.

In an effort to provide a better understanding and point of reference on how fan sound is developed, rated, applied, and controlled, this is the first in a series of four articles covering this topic.

Part 1 - Understanding the Development of Fan Sound Data and the Product Rating Process

Part 2 - The Basics of Fan Sound

Part 3 - Radiated Sound

Part 4 - Sound Criteria, Attenuation Techniques and Preventive Measures to Limit Sound Problems

Quality products that perform in accordance with published data don't occur by accident. It is the end result of extensive aerodynamic testing and sound testing following a comprehensive product development plan.

A company's product development must be state-of-the-art. A company that knows its products and how they perform is always in a better position to serve its customers. This article provides an overview and insight into the thoroughness with which Greenheck tests and rates its products for acoustic performance.

The development process

Product development starts with aerodynamic and acoustic performance goals often determined by the market place. Computational fluid dynamics (CFD) and design history guide the making of a prototype that will satisfy the desired goals. Tests performed in Greenheck's two AMCA registered air test chambers determine aerodynamic performance in accordance with AMCA Standard 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating". Greenheck's AMCA Registered sound facility determines inlet and outlet sound power levels in accordance with AMCA Standard 300, "Reverberant Room Method for Sound Testing of Fans".

The AMCA 300 reverberant room method consists of measuring the sound pressure levels produced by a fan, and those produced by a reference sound source (RSS) in the same acoustic environment; ie, the semi-reverberant room. The RSS sound power level has been previously determined and calibrated by tests conducted at a nationally recognized independent acoustic laboratory. The sound power of a fan is determined by substitution. The sound level of the calibrated reference sound source is measured in a semi-reverberant room. The difference (amount of sound absorbed by the room) between the calibration numbers and what is actually measured is added to the measured values for the test fan.

Unlike most fan manufacturers, Greenheck tests and publishes inlet and/or outlet sound power levels.

However, Greenheck does not stop there. Using AMCA Standard 320, "Laboratory Method of Sound Testing Fans Using Sound Intensity", Greenheck is able to establish the sound power level of the sound radiating from a fan's casing. The casing radiated sound is particularly useful when fans are to be applied next to offices or conference rooms. The concept of using sound intensity to determine sound power is relatively simple. Sound Intensity is the rate of sound energy passing through a unit area. Therefore, if a theoretical enclosure is placed around a fan and the normal average sound intensity passing through the surface area is determined, the sound power of the fan is calculated by multiplying the average sound intensity by the surface area of the enclosure.

The resulting data provided by all AMCA sound test standards is in sound power levels in dB referenced to ten to the minus twelve watts. The sound power level is provided in each of eight octave bands from mid frequencies of 63 Hz to 8 KHz. All test results are consistent and in the same format regardless of the test standard used.

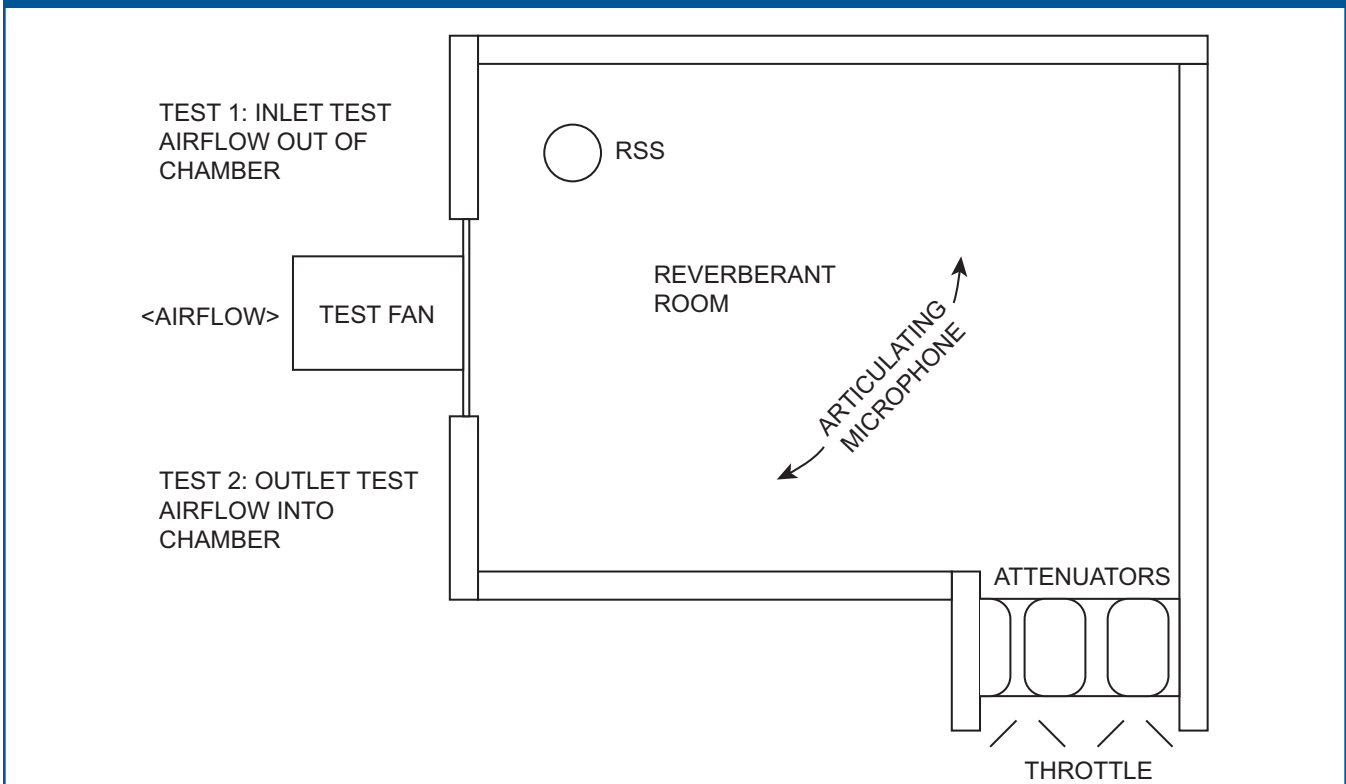
Product line rating process

A product line may consist of one size or several sizes. A key element that determines the accuracy and reliability of fan catalog ratings is how well the sound test data encompasses the range of the catalog and whether the sizes have geometric similarity. Geometric similarity requires that all dimensions and angles must be a constant ratio of a smaller base size which has been tested. If geometric similarity does not exist, then each size must be tested.

Sound does not behave in as predictable a manner as aerodynamic data. Therefore, projections of sound power levels from test data have several rather restrictive limitations in order to maintain good accuracy. Greenheck uses an extremely thorough and conservative rating process encompassing the following guidelines:

- The minimum test size must correspond to the minimum catalog size.
- Fan sizes with wheels under twelve inches in diameter must be tested individually.

AMCA Standard 300 typical test setup for determining inlet and outlet sound power



- Greenheck conducts a sufficient number of tests for each product line to assure accurate and dependable ratings. Larger fans are tested using sound intensity of extrapolated results of smaller fans.
- The minimum test speed will be within five percent of the minimum catalog speed.
- Intermediate test speeds must be within .6 and 1.6 times each other.
- The maximum test speed should approximate the maximum catalog speed.
- The number of test operating points must be no less than four and cover the entire operating range of the catalog. The operating points are incrementally spaced so that they are consistent along a constant system line when more than one size is involved. This means that all operating points are at consistent increments of “percent wide open volume”.

What about non-tested sizes and speeds? There are three distinct processes utilized depending upon the situation.

1. Interpolation may be used when catalog sizes, speeds and operating points are bracketed by known test data.
2. Extrapolation is used when catalog sizes, speeds and operating points are larger than test data. The fan laws based upon the generalized sound format contained in AMCA Standard 301 are used.
3. An alternate method of extrapolation may be used on some products based upon specific sound power. Specific sound power is the sound produced when a fan is operating at one cfm and one inch of total pressure.

AMCA Certified Ratings

Greenheck participates in AMCA’s Certified Ratings Program (CRP). The program stipulates the various rules and regulations for presenting cataloging data; AMCA 211 for aerodynamic performance and AMCA 311 for acoustic performance. Having the AMCA seal is only added assurance that Greenheck fans will work the way we say they will.



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