ANSI/AMCA Standard 301-14

Methods for Calculating Fan Sound Ratings From Laboratory Test Data

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AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL INC.

The International Authority on Air System Components

ANSI/AMCA Standard 301-14

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AMCA Publications

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Related AMCA Documents

Related Publications	AMCA Publication 11	*Certified Ratings Program – Operating Manual*
	AMCA Publication 311	*Certified Ratings Program – Product Rating Manual for Fan Sound Performance*
Related Standards	ANSI/AMCA Standard 300	*Reverberant Room Method for Sound Testing of Fans*
	ANSI/AMCA Standard 320	*Laboratory Methods of Sound Testing of Fans Using Sound Intensity*

Contents

Methods for Calculating Fan Sound Ratings from Laboratory Test Data

1. Purpose

This document establishes standard methods for calculating fan sound ratings from laboratory test data.

2. Scope

This standard applies to any fan, if a test standard exists to measure its fan sound power levels.

3. Symbols and Subscripts

See Table 2.

4. Calculation of Sound Power Ratings

4.1 General

Sound generated by a fan has a variety of sources. These include aerodynamic and mechanical vibration as well as electrical sources that determine the overall acoustic performance of the fan. Sound power level is the established metric for quantifying sound generated by fans. Test standards such as ANSI/AMCA Standard 300, ANSI/AMCA Standard 320 and ISO 5136 describe procedures to test and measure sound power on a fan.

It is desirable to report fan sound power levels across the entire fan performance envelope. However, practical limitations of test laboratory capability and large data requirements, often limit the number of tested sizes, speeds and points of operation. Fan laws for fan sound performance are not as reliable as the familiar fan laws for fan aerodynamic performance, nor are they universally accepted. It is for this reason that sound power ratings are calculated largely by interpolation of available data. This section describes methods for calculating the sound power ratings from base tests.

The basic building blocks for these calculations are the sound power data for a given fan operating at a constant speed. Sound power spectra, in the form of one-third octave or full octave band data, shall be available for at least three points over the usable portion of the air performance curve. Each of these spectra are referred to as determinations. These determinations are used to calculate sound power levels at other points of rating.

The base test determinations are chosen on either side of the rated point of operation. The preferable quantity used as the basis for interpolating the point of operation is the system resistance parameter, but airflow or pressure is also acceptable. For the general case where both the diameter and speed are changed, a diameter-independent variable must be used (see Table 1).

Table 1
Quantities, Variables and Diameter-Independent Variables

Quantity	Variable	Diameter-Independent Variable
Airflow	Q	$\% Q_{max}$
Pressure	P	$\% P_{max}$
System Resistance Parameter	$K = \left(\frac{P}{Q^2}\right)$	$K_D = \left(\frac{P}{Q^2}\right) D^4$

Note: P can be either fan static (P_s) or fan total pressure (P_t)

Base test data may not be available at the extreme points of operation, i.e., wide open delivery, where the sound power levels are usually highest. If the required point of operation is outside the range of determinations tested, extrapolation can be used, but only if the resulting sound power level (L_W) is equal to or higher than the value calculated from the nearest determination. If the result of extrapolation for any of the sound power levels is below that of the nearest determination, the value from the nearest determination shall be used.

Sound determinations may be available at multiple speeds and fan sizes. These additional data, especially at multiple speeds, can greatly enhance the accuracy of the methods described in the following procedure. Calculation of sound power levels from these data to other points of rating follow a number of different procedures, depending on the extent of available sound power data. The procedures involve a variety of interpolation techniques and the application of fan scaling laws.

In order to improve the accuracy of the sound power prediction, it is recommended that calculations be performed using one-third octave band data as opposed to full octave band data.

4.2 Reduction of sound power data to reference values

Traditional sound power scaling methods begin with normalizing or reducing sound power spectra to reference values at reduced frequencies. This is done to conserve computa-