PRODUCT APPLICATION GUIDE

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

Field Testing Overview

This article provides an overview of field testing and how the principles contained in AMCA 203, Field Performance Measurement of Fan Systems, can be applied.

(The AMCA publications described in this article may be obtained from www.amca.org.)

The purpose of a field test is to define, via testing and measurement, the actual aerodynamic performance of a fan when installed in a system. Since installations often include elbows, obstructions, swirl and sudden changes in area, obtaining accurate measurements may be difficult. Additionally, these items may have an impact upon the unit's performance. This impact is called a system effect.

AMCA Field Test Publications

AMCA Publication 203 is a general purpose guide for the measurement of fan performance. This guide is applicable to most air handling equipment installed in any system. It includes the calculation process for loss in performance due to system effects and methods for calculating test results and uncertainties. A wealth of reference material and examples of typical applications pointing out where difficulties may be encountered are included.

People involved in field testing should also be familiar with AMCA's Certified Ratings Program outlined in Publication 211 and the concept of system effect factors (SEF) defined in AMCA Publication 201, Fans and Systems.

Reasons for Field Tests

Three main reasons for conducting a field test are —

1. General System Evaluation- A measurement of the fan and system's performance. This test may be used as a basis for future modifications or adjustment to the system.

2. Acceptance Test- A test specified in a sales agreement to verify that the fan is achieving the specified performance.

3. Proof of Performance Test- A test in response to a complaint to demonstrate that the fan is meeting the specified performance requirement.

Performance Rating Parameters

As already stated, the specific objective of a field test is to determine the aerodynamic performance of a fan when installed in a system. The operating point will occur at the intersection of the system resistance curve and the fan curve. Operation at any other point is impossible without altering either the fan or the system.

An operating point must be fully defined by obtaining test data that allows you to determine each of the following parameters:

1. Flow Rate - The fan flow rate is the volumetric flow rate corrected to the gas density at the fan inlet. The volumetric flow rate at any location in a system can be obtained by measuring the velocity pressure according to a specified grid in the plane of interest. The number and

GREENHECK
Building Value in Air.
P.O. Box 410 • Schofield, WI 54476 • 715.359.6171 • Fax 715.355.2399

distribution of points is stipulated in AMCA 203. The flow in that plane is calculated by converting the average velocity pressure to its equivalent velocity and multiplying by the area of the traverse plane. The flow rate obtained in the measurement plane must be referred back to the fan inlet using the ratio of densities at the measurement plane to that of the fan inlet.

2. Fan Static Pressure - The fan static pressure is the algebraic difference between the static pressure at the fan outlet and the total pressure at the fan inlet. Static pressures using a pitot tube or static pressure taps are obtained near the fan outlet and fan inlet. The total pressure at the fan inlet is a measured value that consists of the sum of the inlet velocity and static pressures..

3. Fan Speed - This is the rotating speed of the fan shaft in revolutions per minute. Typically, measurements of fan speed are obtained at the beginning and end of a test and then averaged providing there is a small difference.

4. Fan Brake Horsepower - This is the power delivered to the fan shaft and does not include any drive losses other than the fan bearings. Nearly all field installations are driven by an electric motor in conjunction with a v-belt drive or variable frequency controller. Portable analyzers are available that read volts, amps, watts and power factor into the motor. Power out of the motor must be calculated using motor efficiency values or the ratio of actual amps and volts to nameplate values when the motor is at least loaded to 90% of full load. Fan brake horsepower values for units with v-belt drives must be calculated using the v-belt drive loss graph in Appendix L of AMCA 203. Units driven by a variable frequency controller must be by-passed to obtain accurate electrical values due to sine wave distortion. These values must then be corrected by the fan laws to the actual operating speed.

5. Fan Gas Density - The fan gas density is the density of the gas being handled at the fan inlet. The inlet density is calculated using the barometric pressure, wet and dry bulb temperature and corrections for suction or pressurized inlet conditions.

Calculation and Analysis of the Results

Detailed calculations are contained in AMCA 203 for obtaining test results. To compare test results with the factory-specified fan curve it is necessary to include SEF values, relevant drive losses, and speed and density corrections. The converted operating points can then be plotted on the factory-AMCA certified performance rating curve for analysis

An estimate of the individual uncertainties for each test parameter must be made. These can be combined to provide an overall uncertainty in flow, pressure and power. An error rectangle is then established around the test point using plus and minus absolute values of the combined uncertainties. Assuming the procedures from AMCA 203 are followed, combined uncertainties range as follows:

Volume	2% to 10%
Pressure	2% to 8%
Horsepower	4% to 8%

Summary

Greenheck products have a proven track record for performing to catalog levels, but keep in mind that the factory tests are conducted in ideal conditions.

Because fans are rarely installed in ideal conditions, field tests are frequently performed. For additional information on installation effects, see Greenheck's article FA/101-99, Understanding System Effects.