

ANSI/AMCA Standard 250-12

Laboratory Methods of Testing Jet Tunnel Fans for Performance

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**AIR MOVEMENT AND CONTROL
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ANSI/AMCA Standard 250-12

Laboratory Methods of Testing Jet Tunnel Fans for Performance



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Related AMCA Documents

Related Publications	AMCA Publication 211	Certified Ratings Program - Product Rating Manual for Fan Air Performance
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Laboratory Methods of Testing Jet Tunnel Fans for Performance

1. Scope

This standard deals with the determination of those technical characteristics needed to describe all aspects of the performance of jet tunnel fans. It does not cover those fans designed for ducted applications nor those designed solely for air circulation, e.g., ceiling fans and table fans.

The test procedures described in this standard relate to laboratory conditions. The measurement of performance under in-situ conditions is not included.

The parties to a test for guarantee purposes may agree on exceptions to this standard in writing prior to the test. However, only tests that do not violate any mandatory requirements of this standard shall be designated as tests conducted in accordance with this standard.

2. Normative References

The following standards contain provisions that, through specific reference in this text, constitute provisions of this American National Standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

AMCA 300-96
Reverberant Room Method for Sound Testing of Fans
Air Movement and Control Association International, Inc.,
Arlington Heights, IL, USA.

ANSI S2.19-1999 (R2004)
Mechanical Vibrations - Balance Quality Requirements of Rigid Motors - Part 1: Determination of Possible Unbalance, Including Marine Applications
American National Standards Institute, New York, NY, USA.

ANSI/AMCA 204-96
Balance Quality and Vibration Levels for Fans
Air Movement and Control Association International,
Arlington Heights, IL U.S.A., 1998

ANSI/AMCA 210-99
Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
Air Movement and Control Association International,
Arlington Heights, IL U.S.A., 2000

ANSI/NEMA MG 1-2003
Motors and Generators
National Electrical Manufacturers Association, Rosslyn, VA,
USA.

ISO 5801:1997(E)
Industrial Fans - Performance Testing Using Standardized Airways
International Organization for Standardization, Geneva,
Switzerland, 1996

3. Definitions and Symbols

3.1 Definitions

For the purposes of this standard, the following definitions apply:

3.1.1 Air

A mixture of various gases forming the earth's atmosphere and commonly used to denote any gaseous medium measured, moved or controlled in a HVAC system.

3.1.2 Standard air

Air with a density of 1.2 kg/m³ (0.75 lbm/ft³), a specific heat ratio of 1.4, a viscosity of 1.819 × 10⁻⁵ Pa•s (1.222 × 10⁻⁵ lbm/ft•sec) and an absolute pressure of 101.325 kPa (408.0 in. wg). Air at 20°C (68°F), 50% relative humidity, and 101.325 kPa (29.92 in. Hg) has these properties, approximately.

3.1.3 Absolute pressure

Pressure above a perfect vacuum; the sum of gauge pressure and atmospheric pressure. The value is always positive.

3.1.4 Barometric pressure

The absolute pressure exerted by the atmosphere at a location of measurement.

3.1.5 Dry-bulb temperature

Air temperature measured by a temperature-sensing device without modifications to compensate for the effect of humidity.

3.1.6 Static pressure at a point

That portion of air pressure that exists by virtue of the degree of compression only. If expressed as gauge pressure, it may be negative or positive.

3.1.7 Volume airflow rate

The volume of air that passes through a given area in unit time.

Actual Cubic Meters per Second (actual m^3/s), or Actual Cubic Feet per Minute (acfm): The actual volume airflow rate at any point in an air system, at the existing density at the plane passing through the point of measurement.

3.1.8 Average air velocity

The volume airflow at a plane divided by the cross-sectional area of that plane.

3.1.9 Fan dynamic pressure

The effective dynamic pressure at the fan outlet calculated from the effective fan outlet velocity and the inlet density. It is representative of the dynamic component of the fan output. The effective dynamic pressure varies from the average dynamic pressure as the former excludes the energy flux due to departures from the uniform axial velocity distribution.

3.1.10 Fan outlet area

The gross inside area measured at the plane(s) of the outlet openings.

- 1) If the silencer centerbody reaches the outlet plane of the fan then the “fan outlet area” is defined as the annulus area at the fan outlet plane as shown in Figure 1A.
- 2) If the fan has a silencer without centerbody, Figure 1B, the outlet area will be close to the cross-sectional area inside the silencer in order to clear any exit bellmouth form.
- 3) For a fan without a silencer, Figure 1C, the outlet area will approach the annulus area between the casing and the motor but with some increase, as defined in the diagram, for the distance between the motor and the outlet.

- 4) Where the motor is on the upstream side, Figure 1C is applied to the impeller hub rather than the motor - as illustrated.

3.1.11 Effective fan outlet velocity

Calculated air velocity based on fan thrust, inlet air density and fan outlet area.

3.1.12 Fan outlet velocity

Average velocity of air emerging from an outlet measured in the plane of the outlet.

3.1.13 Air power

Power output which is the product of the inlet volume airflow and the fan dynamic pressure.

3.1.14 Impeller power

The mechanical power supplied to the fan impeller.

3.1.15 Motor input power

The electrical power supplied to the terminals of an electric motor drive.

3.1.16 Rotational speed

The rotational speed of an impeller. If a fan has more than one impeller, fan speeds are the rotative speeds of each impeller.

3.1.17 Mean blade speed

The tangential velocity at $1/\sqrt{2}$ (or 0.7071) times the blade height between impeller hub and tip.

3.1.18 Thrust

The force exerted by a fan in a specific direction.

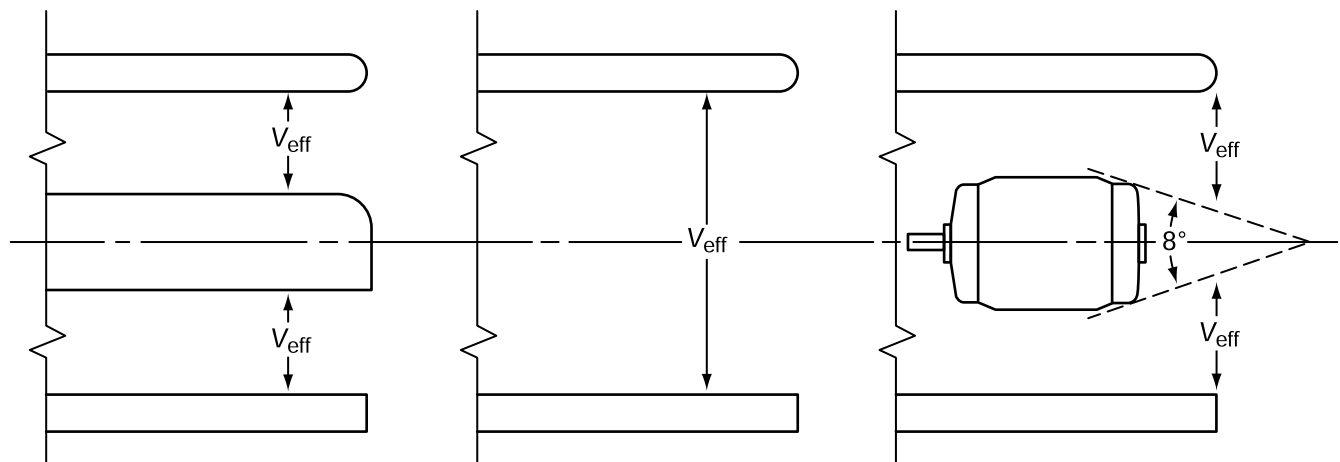


Figure 1A
Silencer With Center Body

Figure 1B
Silencer Without Center Body

Figure 1C
Silencer With Electric Motor

Figure 1
Effective Fan Outlet Area

3.1.19 Fan efficiency

Ratio of the air power to the impeller power, expressed as a percentage.

3.1.20 Overall efficiency

Ratio of the air power to the motor input power, expressed as a percentage.

3.1.21 Thrust/power ratio

Ratio of the thrust to impeller power.

Note: An alternative definition of thrust efficiency is defined as thrust divided by the motor input power. This results in a lower figure as the motor losses are also included.

3.1.22 Fan

A device that utilizes a power driven rotating impeller for moving air or gases. The internal energy (enthalpy) increase imparted by a fan to a gas does not exceed 25 kJ/kg (10.75 BTU/lbm).

3.1.23 Jet tunnel fan

A fan used for producing a jet of air in a space and unconnected to any ducting. Typical function is to add momentum to the air within a duct or tunnel.

3.1.24 Fan guard

A screen or other device to prevent ingestion of objects at the inlet or outlet of a fan.

Note: Guards can have a marked effect on the thrust performance and sound level. Where they are specified, it shall be made quite clear between the supplier and his customer whether the performance includes the effect of the guards.

3.1.25 Chamber

An airway in which the air velocity is small compared to that at the fan inlet or outlet.

3.1.26 Test enclosure

A room, or other space used for the purposes of testing.

3.1.27 Sound power level, L_w

Acoustic power rating from a sound source measured in decibels and equal to 10 times the logarithm (base 10) of the acoustic power in watts with reference to 10×10^{-12} watts.

3.1.28 Sound pressure level, L_p

The acoustic pressure at a point in space where the microphone or listener's ear is situated. It is defined as 20 times the logarithm (base 10) of the sound pressure fluctuation with reference to $20 \mu\text{Pa}$.

3.1.29 Frequency range of interest

The frequency range including the octave bands with center frequencies between 63 Hz and 8 kHz, and the one-third

octave bands with center frequencies between 50 Hz and 10 kHz.

3.1.30 Impeller balance grade

The impeller balance specification in accordance with the method detailed in ANSI S2.19 and to the grade specified in ANSI/AMCA 204.

3.1.31 Fan vibration velocity

The filtered vibration velocity in the frequency range 10 Hz through 10 kHz measured in accordance with this standard.

3.1.32 Shall and should

In AMCA standards, the word "shall" is understood to be normative; the word "should" as advisory.

3.2 Symbols

See Table 1 for a list of symbols.

4. Characteristics to be Measured

4.1 General

In order for a jet-type tunnel fan to be correctly applied and give satisfactory performance and reliability in service, it is necessary to determine a number of technical performance characteristics in addition to knowing the more obvious mechanical features such as weight and overall installation dimensions.

4.2 Volume airflow rate

Volume airflow rate need only be measured if required for contractual reasons. The effective outlet velocity, not the volumetric airflow rate, is used to evaluate the optimum number, size and spacing of jet fans in a tunnel. Higher velocities reduce thrust efficiency but the effect of tunnel air velocity on thrust is reduced.

4.3 Thrust

Friction on the tunnel walls, inlet and outlet losses and, sometimes, traffic drag combined with gradients and wind effects at tunnel portals, result in a pressure drop through the tunnel. The pressure drop is matched by the sum of the pressure increases by the jet fans due to the momentum transfer between the fan discharge airflow and the airflow in the tunnel. As it is impossible to measure the momentum of the fan discharge airflow, and the rate of change of momentum is equal and opposite to the thrust, thrust is measured instead.

The process of providing additional momentum to the tunnel air helps to maintain air quality.

