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CHAPTER 32

FANS

Types, Fan Performance, Fan Laws, Fan Performance Curves, System Characteristics, Fan Arrangements, Fan Control, Motive Power, Fan Selection, Fan Installation, Fan Applications

FANS are divided into two general classifications: (1) *centrifugal or radial flow*, in which the air flows radially through the impeller within a scroll type housing, and (2) *axial flow*, in which the air flows axially through the impeller within a cylinder or ring.

Centrifugal fans are further subdivided into types denoted by the curvature or slope of the impeller blades, the angle of which largely determines the operating characteristics. For a given output, a forward inclination of blade indicates a relatively low speed of operation, and a backward inclination indicates a relatively high speed of operation. Many intermediate forms are also found.

Axial-flow fans are subdivided into types differentiated mainly by their enclosures and refinements of impellers and appurtenances. All types vary in shape, number, and angles of blades, ratios of hub diameter to impeller diameter, materials and methods of fabrication, depending upon design and preference of manufacturer. *Tubeaxial* and *vaneaxial* fans, usually used against appreciable resistance, commonly have relatively large hubs and helical blades (the angle varies radially along the blade). The blades may be of uniform thickness, either flat or cambered, and either cast or made of plates, or they may be of air-foil sections, either cast or formed sheet. *Vaneaxial* fans incorporate guide vanes to modify performance and increase efficiency. *Propeller* fans customarily used for free delivery, or against low resistance, also are found with a variety of blade conformations, but are simple in construction. They are merely mounted within a plate or ring.

The fan nomenclature in Fig. 1 has been standardized by the Air Moving and Conditioning Association.[1]

FAN PERFORMANCE

Fan performance is a statement of volume, total pressures, static pressures, speed, power input, mechanical efficiency, and static efficiency, at a stated density. These terms are defined by the Air Moving and Conditioning Association[1] as follows:

1. *Volume* handled by a fan is the number of cubic feet of air per minute expressed at fan inlet conditions.

2. *Total pressure* of a fan is the rise of pressure from fan inlet to fan outlet.

3. *Velocity pressure* of a fan is the pressure corresponding to the average velocity determination from the volume of air flow at the fan outlet area.

4. *Static pressure* of a fan is the total pressure diminished by the fan velocity pressure.

5. *Power output* of a fan is expressed in horsepower and is based on fan volume and the fan total pressure.

6. *Power input* to a fan is expressed in horsepower and is measured horsepower delivered to the fan shaft.

7. *Mechanical efficiency* of a fan is the ratio of power output to power input.

8. *Static efficiency* of a fan is the mechanical efficiency multiplied by the ratio of static pressure to the total pressure.

9. *Fan outlet area* is the inside area of the fan outlet.

10. *Fan inlet area* is the inside area of the inlet collar.

While the total pressure truly represents the actual pressure developed by the fan, the static pressure may best represent the useful pressure for overcoming resistance. In many installations, since the outlet velocity of the fan is greater than the duct velocity, some of the velocity pressure may be utilized by conversion to static pressure within the system. However, due to the uncertainty of the flow at the

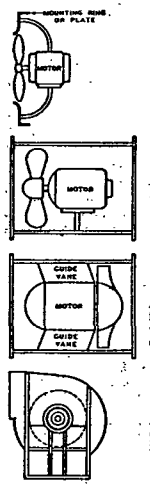

Fig. 1. . . . Names and Definitions of Types of Fans

The general responsibility for this chapter is assigned to TC 4.2, Fans.