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## CHAPTER 33

# FANS

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

IN HEATING, ventilating and air conditioning practice, the devices used to produce air flow are variously known as fans, blowers, exhausters or propellers. The *A.S.M.E.* Test Code[1] limits fans to those in which the fluid density change does not exceed 7 percent (one psi at atmospheric pressure) and labels as compressors those devices operating beyond that pressure range. Since air conditioning rarely requires pressures of over ½ psi, all such devices will be known as *fans* and the air will be considered non-compressible.

### Types

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, 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 of double thickness sheet. Streamlining of both impeller and enclosure is common practice. *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 *National Association of Fan Manufacturers*.[2]

## FAN PERFORMANCE

Fan performance is a statement of volume, total pressures, static pressures, speed, power input, mechanical and static efficiency, at a stated density. These terms are defined by the *National Association of Fan Manufacturers*[2] as follows:

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