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G95-1243 Ventilation Fans: Types and Sizes

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Ventilation Fans: Types and Sizes

This publication describes the most common types of ventilation fans and compares their physical and performance characteristics.

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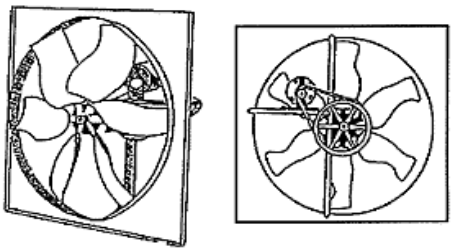
Two general types of ventilation fans are commonly used for agricultural applications. Each type has many different blade diameters, materials, blade shapes, speeds, and motor horsepowers available. The desired airflow rate and the resistance to airflow through the ventilation system, or static pressure capabilities, are the two primary considerations when selecting a ventilation fan. Other considerations include maintenance requirements, noise levels, and energy efficiency.

a) Direct-drive fan, front and rear view.



b) Belt-drive fan, front and rear view.

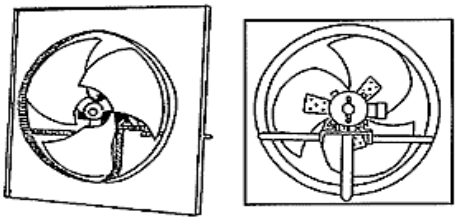


Figure 1. Propeller fans (shown without safety guards for clarity).

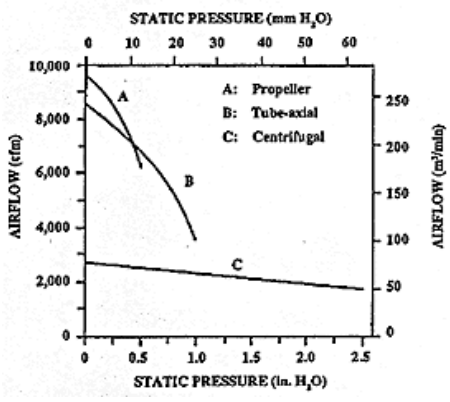


Figure 2. Fan performance curves for typical propeller, tube-axial, and centrifugal fans. All fans are from one manufacturer and have 1 1/2 horsepower motors.

Fan Types

The two general types of fans are axial-flow and centrifugal. With axial-flow fans, the air passes through the fan parallel to the drive shaft. With centrifugal fans, commonly used for grain drying applications, the air makes a right angle turn from the fan inlet to outlet.

Axial-flow fans can be subdivided based on construction and performance characteristics:

1. *Propeller fans (Figure 1)* -- Propeller fans are most commonly used for ventilating livestock buildings. They perform most efficiently with static pressure in the range of 0.05 to 0.25 inches of water (in. H_2O). The basic design of propeller fans enhances maintenance to remove dust and dirt accumulations. The fan normally consists of a "flat" frame or housing for mounting, a propeller-shaped blade, and a drive motor. Propeller fan characteristics are summarized in *Table I*. A performance curve for a typical propeller fan is shown as *line A* in *Figure 2*.

Table I. Typical characteristics of propeller fans.	
Motor horsepower	1/100 to 5
Blade diameter	6 to 72 in.
Static pressures	0 to 0.5 in. H_2O
Drive	Direct or belt
Common uses	Livestock building ventilation and air circulation

2. *Tube-axial fans (Figure 3)* -- A tube-axial fan consists of a tube-shaped housing, a propeller-shaped blade, and a drive motor. Generalized characteristics are listed in *Table II*. A performance curve for a typical tube-axial fan is shown as *line B* in *Figure 2*.

Table II. Typical characteristics of tube-axial fans.	
Motor horsepower	1/4 to 15
Blade diameter	12 to 60 in.
Static pressures	0 to 3.5 in. H_2O
Drive	Direct or belt
Common uses	Grain aeration

Vane-axial fans are a variation of tube-axial fans, and are similar in design and application. The major difference is that air straightening vanes are added either in front of or behind the blades (*Figure 4*). This results in a slightly more efficient fan, capable of somewhat greater static pressures and airflow rates.

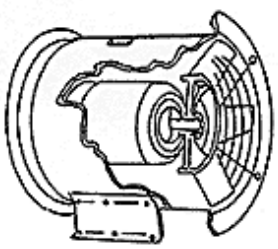


Figure 3. Tube-axial fan.

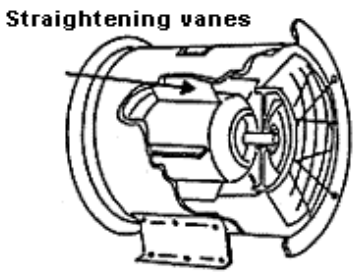


Figure 4. Vane-axial fan. Note the air straightening vanes on the motor.

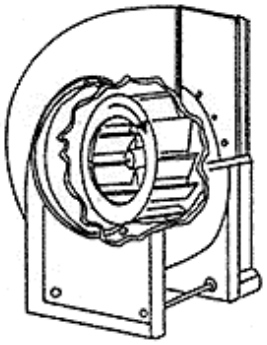


Figure 5. Centrifugal fan.

Centrifugal fans, often called "squirrel cage" fans, have an entirely different design (*Figure 5*). These fans operate on the principle of "throwing" air away from the blade tips. The blades can be forward curved, straight, or backward curved (*Figure 6*).

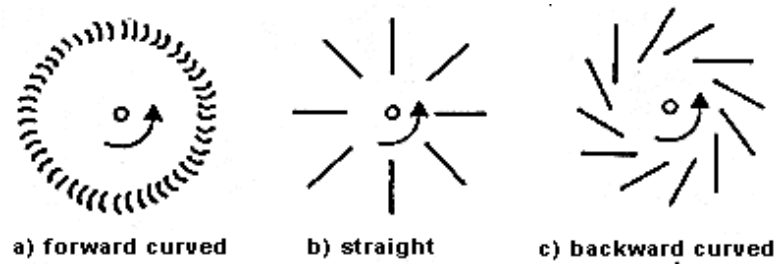


Figure 6. Schematic of centrifugal fan blade configurations.

Centrifugal fans with backward curved blades are generally more efficient than the other two blade configurations. This design is most often used for grain drying and aeration applications where high airflow rates and high static pressures are required. Centrifugal fans with forward curved blades have somewhat lower static pressure capabilities but tend to be quieter than the other blade designs. Furnace fans typically use a forward curved blade. An advantage of the straight blade design is that with proper design it can be used to handle dirty air or convey materials. Dust collectors and silage blowers are examples of straight-blade centrifugal fans.

Table III. Typical characteristics of centrifugal fans.	
Motor horsepower	1/4 to 30
Blade diameter	6 to 96 in.
Static pressures	0 to 10 in. H_2O
Drive	Direct or belt
Common uses	Grain drying

Centrifugal fans characteristically have very "flat" performance curves (*line C, Figure 2*). This means they deliver a nearly constant volume of air over a wide range of static pressures. In addition, they are generally capable of developing much greater static pressures than axial-flow fans. These characteristics make centrifugal fans well suited for many grain drying applications, especially when system static pressure

levels exceed about 4.0 in. H_2O. As a general rule, centrifugal fans are quieter than axial-flow fans, especially when operating at high static pressures. Generalized characteristics of centrifugal fans are listed in *Table III*.

Fan Sizes

Two measurements are commonly used to describe the physical characteristics of a fan -- blade diameter and motor horsepower. While these are useful measures, without the performance characteristics (airflow rate and static pressure capabilities) they only give a very general idea of fan capacity. This is readily illustrated by using fan performance data to compare fans from a single manufacturer. The performance curves of five 24-inch diameter fans are shown in *Figure 7*. Airflow rates range from 5,800 to 9,500 cubic feet of air per minute (cfm) at 0 in. H_2O, depending on motor horsepower and fan speed. Blade diameter alone obviously does not describe a fan's performance.

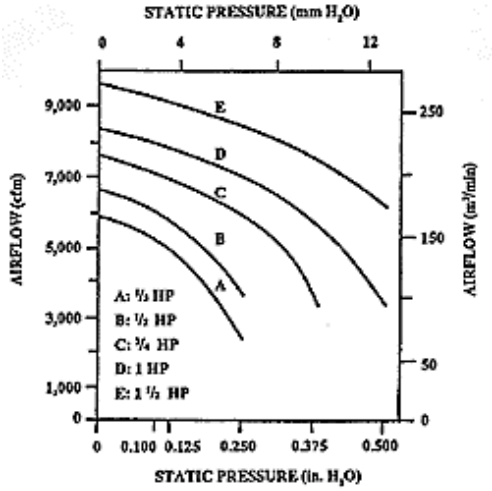


Figure 7. Performance curves for five ventilation fans from one manufacturer. All fans are 24 inches in diameter and are direct-driven.

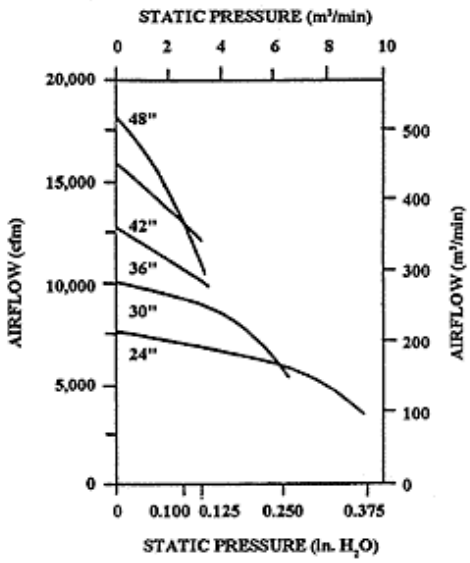


Figure 8. Performance curves for five ventilation fans from one manufacturer. All fans equipped with 3/4 horsepower, direct-drive motors.

Similarly, motor horsepower does not completely describe fan performance. Performance curves for five fans with 3/4 horsepower motors are shown in *Figure 8*. Airflow rates (at 0 in. H_2O) range from 7,500 cfm for the 24-inch diameter model to approximately 18,000 cfm for the 48-inch diameter fan. At a static pressure of 0.1 in. H_2O, the 48-inch and 42-inch diameter models have the same air delivery rate.

Even fans with the same blade diameter and motor horsepower can have markedly different performance. Performance curves for six 36-inch diameter fans, all with 1/2 horsepower motors are shown in *Figure 9*. In all cases, when selecting or comparing fans, the specific performance characteristics must be known.

Although airflow at 0 in. H_2O static pressure was used for illustration purposes, these values have little meaning in ventilating a building or aerating grain. All ventilation systems have some resistance. As shown in *Figures 2, 7, 8,* and *9*, airflow of all fans decreases as static pressure increases. In some

instances, the changes are appreciable. As a general rule, fans operating at low speed experience the most significant decrease in airflow capacity as static pressure increases.

Fans must be selected based on their performance as part of a total system if the desired results are to be achieved. A recommended practice is to select only fans with performance certified by the Air Movement and Control Association (AMCA). Fans having this certification are more certain to perform in accordance with specifications printed in the manufacturer's literature. Also, particularly if the fan is to be used for livestock building ventilation, specify fiberglass, stainless steel, plastic, or epoxy coated housings.

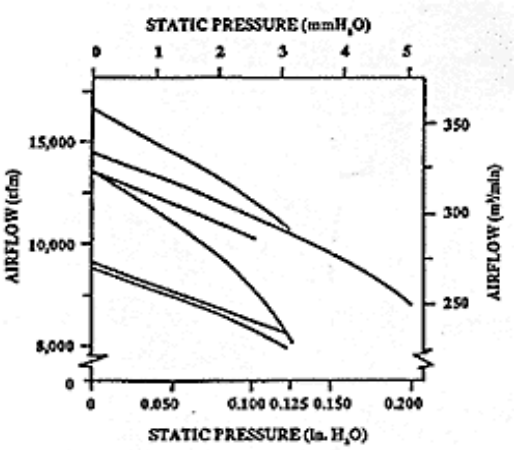


Figure 9. Performance curves for six ventilation fans from four different manufacturers. All fans are 36 inches in diameter and have 1/2 horsepower motors.

Summary

Two general types of fans are commonly used for agricultural applications -- axial-flow and centrifugal. Axial-flow fans can be subdivided into propeller, tube-axial, and vane-axial types. Depending on the specific use, one type of fan is usually most appropriate. For example, for livestock building ventilation systems where static pressures are typically only about 0.10 to 0.125 in. H_2O, a propeller fan is usually best. For static pressures in excess of 4.0 in. H_2O, such as might be encountered in a grain drying application, a centrifugal fan is often the most suitable choice. Tube-axial fans are well suited for grain aeration systems with lower airflow and static pressure requirements. Regardless of the application, the required airflow rate must be determined and static pressures estimated before purchasing a fan.

Motor horsepower and blade diameter are the two common measurements used to describe the physical characteristics of a ventilation fan. While these measurements are useful, actual performance characteristics must be used to select a fan for a specific application.

For additional information on ventilation fans, refer to NebGuides 95-1242, *Ventilation Fans: Performance*, and 95-1244, *Ventilation Fans: Efficiency and Maintenance*, available from the Cooperative Extension office serving your area.

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