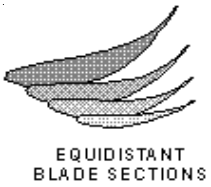
HOW TO RECOGNIZE A HIGH-EFFICIENCY FAN



The most important requirement of a fan wheel is that it must impart to the air stream a uniform velocity and pressure over its entire area. Any well-designed axial flow fan wheel is sure to have two characteristics:

1. The individual blades will be narrow at the tip, where the blade velocity is high, and will widen toward the hub, where more blade area is required due to lower blade velocity.

2. The angle of the blades to the plane of rotation will be minimum at the tip and increase as the hub is approached. Only with such calculated width and angle for each point on the blade can the design considerations of uniform velocity and pressure be accomplished.

The drawing at right represents equidistant profiles of an end view of a well-designed blade. Note that from the thin, narrow tip to the thick cambered root, each section has the proper combination of airfoil camber, width and angle to provide uniform pressure and velocity from the hub to the tip. This is the criterion of efficient axial flow fan design.

The necessity for uniform flow and pressure is easily explained: If certain portions of the blade are not able to develop the pressure necessarily being carried by other portions of the blade, back flow of air at these points will occur. Such would be the case in the vicinity of the hub if a typical airplane propeller were adapted as an axial flow fan.

Unequal discharge velocities will waste power in excess velocity pressure. Since velocity pressure increases as the square of the velocity, unequal discharge velocities, when converted into velocity pressure, will average out to a higher overall velocity pressure than if the velocity were uniform over the discharge area. For this reason, fans which develop the greater part of their velocity and pressure near the blade tip will invariably fall short when efficiencies are considered.

For example, a fan of 80% efficiency with a uniform discharge velocity of 2000 FPM would have a velocity pressure of 0.25". Imagine another fan in which 1/2 of the air volume being handled left the fan at 1000 FPM while the other half left at 3000 FPM. The velocity pressure of the first half would be 0.06", while the velocity pressure of the second half would rise to 0.56", making the work done on the air, neglecting the static pressure, the equivalent of the average of the two, or 0.31" velocity pressure. Were this unit handling air at zero static pressure, its efficiency would be .25/.31 of the efficiency of the unit with uniform flow, or about 65% as compared to 80% for the fan with uniform flow.

Even a perfectly designed fan will operate at lower efficiency if its surroundings cause serious disturbance to the airflow pattern. Moore is currently preparing an Engineering Paper on the effects of inlet conditions, tip seal and other factors that influence fan performance.

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