pulls the airplane along like a "tractor." The pusher prop is mounted on a rear-facing engine and pushes the airplane from behind. One twin-engine aircraft, the Cessna 337 Skymaster, uses a tractor prop on the nose of the fuselage and a pusher prop on the back. The aircraft has twin-engine performance with the safety and ease afforded by centerline thrust, which does not present an asymmetric thrust controllability problem should one engine fail.

While most light aircraft have two-bladed propellers, three or more blades are very common on high-performance singles and multiengine aircraft. There are several advantages to having more than two blades. The individual blades can often be shorter, allowing increased ground clearance, without a decrease in performance. Shorter blades have higher, and less objectionable, sound frequencies and an overall reduction in vibration. The additional blades also produce a greater flywheel effect and generally improve aircraft performance at takeoff and climb speeds.

Propeller tips may be rounded or squared, depending on noise requirements, blade-vibration characteristics, and other special design considerations. Tests have shown that elliptical tips are slightly more efficient than square ones, but that's not the reason square tips are more common; they're more practical. Square tips leave extra material, which can be removed after damage occurs, turning them into round or elliptical tips, for instance, and still maintain the required prop diameter. That's important because prop diameter (the circle circumscribed by the blade tips) is carefully designed for maximum efficiency. Slower aircraft will use a larger diameter while high performance aircraft will have smaller diameter props. The longer the propeller blade, the greater the distance the tip must travel during each revolution. High-speed aircraft engines can cause the tips of long propeller blades to reach the speed of sound. This results in significant aerodynamic breakdown, vibration, and reduced performance.

Terminology

Two terms that frequently confuse pilots are prop face and camber. A look at Figure 9-1 will help clear up some propeller terminology. The flat side of the propeller, which faces the pilot, is called the face; the opposite, cambered side is, logically enough, called the back or camber side.

Blade angle is the angle between the plane of rotation and the chord line of a given propeller airfoil section. Blade angle decreases along the length of the blade (called pitch distribution) with the greatest angle nearest the hub. The reason a prop has pitch distribution is because the tip must travel at a higher relative velocity than the hub. To see an example of this, tie a key to a length of string and spin it over your head. The key and string, essentially one continuous object, must turn at the same RPM (revolutions per minute), but the key covers significantly more distance. This is where the prop most significantly differs with the wing, which is an airfoil with a fairly constant relative wind throughout its span. Pitch distribution attempts to make the prop efficient along its entire length to obtain maximum forward movement. The distance a prop section moves forward in one revolution is called pitch and is measured in inches. The amount of lift produced by any given prop will vary with airfoil shape, angle of attack on blade sections, and prop RPM.