

Propeller Balancing

Under the best of circumstances, props go out of balance with age, primarily from blade erosion. An out-of-balance prop results in vibration, which leads to the premature failure of such parts as the alternator, fuel control, engine wiring harness, and avionics. It also causes oil cooler leaks; broken or cracked engine mounts, exhaust manifolds, and turbocharger mounts; and sheet metal cracks in the fuselage and cowlings. There are two approaches to balancing a propeller: static and dynamic.

To static balance a prop, it must be removed from the airplane and put on a stand in a shop. The problem with this method is it doesn't take into account the effect of the engine, its accessories, bulkhead, and prop spinners. Dynamic balancing is accomplished while the propeller is on the airplane, taking all aerodynamic forces into account. Also, it can be done at different RPM settings. Many shops now use the Chadwick-Helmuth Vibrex Dynamic Balancer. With this system, nothing is removed from the propeller or the engine; it uses a small velocimeter to measure movement produced by the out-of-balance condition at different RPMs. The instrument then tells the mechanic how much weight must be added to the hub to balance the prop; the process is analogous to dynamic balancing of tires on a car.

It is recommended that a prop be balanced every time it, or the engine, is overhauled. Some manufacturers also suggest a prop should be balanced at 500-hour intervals. It's also a good idea to have it balanced whenever you have a cylinder reworked, after any significant repairs to the prop or engine, and at the onset of any unusual vibration. The benefits are immediate and noticeable. The vibration disappears and you get the long-term benefit of extended component life.

PROPELLERS AND THE FARs

The manufacture of propellers is very tightly controlled by Federal Aviation Regulations (FARs). They not only define the limitations of the prop but also its effect on the engine. The single engine prop must limit engine RPM to the maximum allowable when the engine is at full power and the aircraft is at its best rate of climb speed. The purpose of this requirement is to prevent engine damage due to overspeed. It is for this reason that during maximum-power ground runup in a zero wind condition, you are unable to reach redline on the tachometer. In addition, the prop must prevent the engine from exceeding rated RPM by no more than 10 percent in a closed throttle dive at the aircraft's "never exceed" speed. The constant speed prop must always restrict the engine to rated RPM during normal operations. In the event of governor failure, static RPM must not exceed 103 percent of the rated RPM. This is essentially what determines where the manufacturer sets the low blade (high RPM) angle.

Similarly, after years of practically no standardization, the FARs now detail the design of cockpit controls and instruments. Forward movement of controls produces an increasing effect so mixtures enrichen, prop RPM gets higher, and forward thrust increases. An aft movement of the throttle on an aircraft with thrust reverse will place the prop blade at a negative angle and increase the reverse thrust. It is also required that