Log 2279

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SR-1

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 27, 1991

In reply refer to: A-91-26

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On December 15, 1989, at 1740 hours Pacific standard time, a homebuilt Crawford-Gordon, Thorp T-18, N111GC, collided with the terrain 14 miles northeast of Austin, Nevada. The airplane was destroyed, and the certified private pilot was fatally injured.

Investigation of the accident has disclosed that during the flight, the pilot made an unscheduled landing at the Austin airport and placed a telephone call to a family member to whom he expressed concern that the airplane was experiencing a vibration. The airplane departed Austin at about 1730 hours and crashed 14 miles from the airport. The investigation is continuing.

Examination of the wreckage after the accident revealed that one of the two propeller blades was broken. An outboard section of the broken blade was missing from the wreckage and was not recovered. Based on the length of the unbroken blade, the diameter of the propeller was 68 inches before it broke. The recovered portion of the propeller was sent to the materials laboratory of the National Transportation Safety Board for metallurgical analysis.

The propeller was manufactured by Sensenich Corporation as model M-74DM. It was a one-piece, fixed-pitch, two-blade type; was made from an aluminum alloy; and was manufactured with a 74-inch diameter. According to a Sensenich representative, the propeller had been sold to Piper Aircraft Corporation on February 16, 1965. Airplane maintenance records indicated that the propeller was installed on N111GC in August 1979. At that time, the airplane was equipped with a 135-horse power (hp) engine: Lycoming O-290-G032K. That engine was replaced later with a 160-hp engine: Lycoming O-320-E2A. At the time of the accident, the propeller had an estimated total flight time of 1,579 hours; less than 20 hours of this time was on the O-320 series engine. Maintenance records did not reveal when the diameter of the propeller had been reduced to 68 inches.

Fracture of the broken blade occurred near the middle of its length (about 17 inches from the tip). Examination of the fracture surface revealed characteristics typical of fatigue cracking throughout 85-90 percent

of the blade's cross section. Examination also revealed that the fatigue crack originated on the cambered side of the blade at the point of maximum camber.

The Safety Board is aware of two other instances of propeller blade failure on the same basic model propeller installed on homebuilt airplanes. In both cases, the propellers were powered by O-320 series Lycoming engines and their diameters had been reduced to 68 inches. In both cases, failures occurred by fatigue that originated 17 inches from the tip of the blade, on the cambered side, at the point of maximum camber.

The Safety Board concluded that failure of the blade from N111GC was caused by high cycle fatigue stresses induced by a resonant vibration of the propeller. This conclusion is further supported by the results of previous testing performed on another M-74 Sensenich propeller cut to 68 inches in diameter. That testing consisted of a comprehensive, in-flight vibration survey conducted on a homebuilt Thorp T-18 airplane powered by a O-320 series Lycoming engine. The experiments showed that when the propeller operated above 2,500 rpm, the actual vibratory stresses at a point located 17 inches from the tip of the blade exceeded the allowable level by more than 2,000 psi.

Due to the complexity of a propeller design and the susceptibility of a propeller to failure when operated at speeds that excite resonance, propeller manufacturers ordinarily determine the vibration characteristics for each of their propeller designs. When the propeller diameter is changed, the propeller's vibration characteristics are also changed. Type Certificate (TC) P-886, issued for the original M-74DM Sensenich propeller, specifies a minimum propeller diameter of 72 inches for both the Lycoming O-320 series and Lycoming O-290-D, -D2, and -D2B. Furthermore, the TC states that from a vibration standpoint "no reduction below the minimum diameter listed is permissible."

The failure of the propeller was "catastrophic"; that is, the service stresses were high and the fracture occurred in a relatively short time. Because the diameter of the propeller was changed, the propeller vibrated during normal engine operation at resonant frequencies that induced stresses far exceeding its design fatigue limit. With such a mode of failure, it is not feasible to predict when failure will occur; thus, it is not possible to determine, with confidence, an interval for inspection that could detect fatigue cracking before the complete failure would occur.

The Safety Board is concerned that other homebuilt airplanes may be equipped with the same combination of propeller and engine; that is, a reduced-diameter Sensenich propeller powered by a Lycoming O-320 series engine. This combination may lead to fatigue failure of the propeller, resulting in another serious accident.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Notify owners of homebuilt airplanes, the Experimental Aircraft Association, field inspectors, and homebuilt aircraft manufacturers, through a general aviation airworthiness alert or other appropriate method, about the potential danger of combining a Sensenich-manufactured propeller, basic model M-74DM, with a Lycoming O-320 or Lycoming O-290-D, -D2 and -D2B series engine when the diameter of the propeller has been reduced below 72 inches, and recommend that airplanes having this combination of propeller and engine be removed from service. (Class II, Priority Action) (A-91-26)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members BURNETT, LAUBER, and HART concurred in this recommendation.

By: James L. Kolstad
Chairman