

Log 9334



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: January 2, 1992

In reply refer to: A-91-129 and-130

Honorable Barry L. Harris
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 21, 1991, a Saab 340A airplane, operated by Comm Air as flight 3039, sustained minor damage when the right propeller separated from the airplane during descent to Toronto, Ontario, Canada. The flight crew declared an emergency and diverted to Buffalo, New York, where the airplane landed without incident. There were no injuries to the occupants. Flight 3093 was operating in accordance with 14 CFR 135, as a regularly scheduled flight between Cincinnati, Ohio, and Toronto when the incident occurred.

Flight 3039 was at 21,000 feet when the flight crew detected a vibration from the right propeller. The crew thought it was a propeller deicing problem and requested a series of lower altitudes in an attempt to get into warmer air and shed the ice. During the descent, the vibration increased. The airplane was in level flight at 8,000 feet when the right engine was shut down due to the vibration. The right propeller separated from the engine as it was being feathered. The first officer saw the propeller travel away from the fuselage parallel to the wing leading edge until it passed the wing tip. The incident happened while the airplane was over Lake Erie.

Examination of the engine revealed that the propeller gearbox output shaft (propeller shaft) had separated near its forward end, just aft of the flange to which the propeller hub is bolted. After separation of the shaft, there was no indication that the propeller assembly contacted the airplane. The propeller shaft was removed from the gearbox and taken to the materials laboratory of the Safety Board for examination. Radar data was used to determine the approximate position of the in-flight separation and the probable location of the propeller assembly in Lake Erie. Searches have been conducted; however, the propeller has not been recovered.

The separated propeller shaft, P/N 775801, is part of a gearbox that had accumulated a total of 10,638 hours (the propeller shaft is not life limited). The greatest number of hours accumulated by any P/N 775801 shaft in the fleet is over 14,000; thus, the number of hours accumulated on the separated shaft is about 75 percent that of the shaft with the most hours. The propeller shaft and gearbox were initially designed by Hamilton Standard. General Electric currently manufactures the shaft and gearbox as part of the General Electric CT7 engine. This engine is used on more than 300 Saab 340 and Casa 235 airplanes.

Metallurgical examination of the separated shaft at the Safety Board's materials laboratory revealed that fatigue cracking had progressed most of the way around the shaft circumference prior to final separation. Although the features in the initial portion of the fatigue crack had been destroyed by damage and rubbing, undamaged features in nearby areas indicated that the cracking began on the outside surface of the shaft, in the radius between the shank portion and flange at the forward end of the shaft. Because damage was present on the fracture surface, the examination could not determine if the cracking initiated from a small number of discrete points or from many sites.

The portion of the shaft that remained with the gearbox contained only a small remnant of the radius between the shank and flange. However, the portion of the radius that did remain with the shaft contained a series of regularly spaced axial marks that extended from the fracture surface, through the radius, and onto the shank portion of the shaft. A shot-peened texture and a layer of cadmium plating were superimposed over the axial marks, as well as over a shallow circumferential groove that was located slightly outside of the radius. The axial marks were estimated to have a maximum depth of about 0.0005 inch. Also, measurements indicated that the curvature of the radius was uniform but was slightly below the range of 0.240 inch to 0.260 inch specified by the part's engineering drawing. These factors indicate that the radius may have been ground at some point. A metallographic section through the radius showed no sign of overheating effects associated with abusive grinding.

The metallurgical examination disclosed no evidence of any type of defect that, by itself, would account for fatigue initiation. In addition, the microstructure of the shaft appeared normal, the hardness of the shaft was at or slightly above the specified hardness range, and chemical analysis indicated that the shaft material complied with composition requirements. Because no serious defect was found in the separated shaft, the Safety Board is concerned that the conditions that contributed to initiation of the crack on the separated shaft could also exist on other CT7 engines, and that it is possible that other propeller shafts could contain or develop cracks. Although no structural damage resulted from this occurrence, it is possible that a separated propeller could contact the airplane with catastrophic results.

On December 6, 1991, General Electric issued an all-operators wire recommending that operators of the CT7 engine perform a one-time fluorescent penetrant inspection of the propeller shaft. The wire recommends that shafts with more than 9,000 hours be given inspections on a priority basis, but that all shafts on installed engines be inspected within 30 days. The wire also recommends that spare shafts be inspected within 90 days. General Electric has reported that as of December 27, 1991, 316 shafts have been inspected and no cracks have been detected. The Safety Board believes that most operators will perform these important inspections in a timely manner. However, the Safety Board is concerned that because performance of the inspection is not mandatory, some shafts may not be inspected. Further, the Board is concerned that the all-operators wire does not recommend that the inspection be repeated on a regular basis.

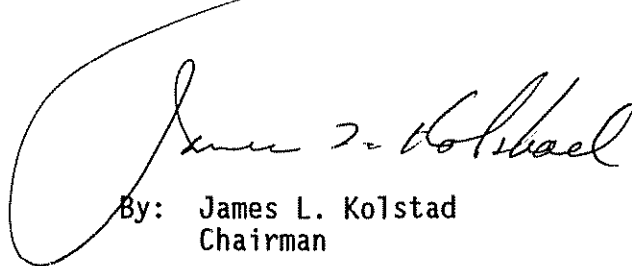
The Safety Board concludes that the engine vibration noticed by the flight crew was the result of the presence of extensive cracking in the propeller shaft, and that the vibration was a sign of the imminent separation of the propeller from the gearbox. The Safety Board is concerned that, should another propeller shaft develop similar cracking that leads to noticeable engine vibration in flight, the flight crew may not recognize that the vibration is a sign of a potentially catastrophic condition and may continue to operate the engine until the propeller separates. The Board believes that operators of airplanes powered by General Electric CT7 engines need to be informed of the potential danger of engine vibration and of the need to consider shutting down a vibrating engine.

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

Issue an airworthiness directive, applicable to all General Electric CT7 engines, to require an immediate inspection, using an FAA approved method, of all P/N 775801 propeller gearbox output shafts with 5,000 flight hours or more and an expedited inspection of all lower-time shafts. The airworthiness directive should require that the inspection be repeated within prescribed intervals to ensure that any cracks that develop are detected before separation of the shaft. (Class I, Urgent Action) (A-91-129)

Issue an alert bulletin to all operators of the CT7 engine to inform pilots of the circumstances of the propeller separation incident that occurred on November 21, 1991, and to advise the pilots to consider shutting down a vibrating engine as soon as practical. (Class I, Urgent Action) (A-91-130)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in these recommendations.



By: James L. Kolstad
Chairman