National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 30, 2006

In reply refer to: A-06-54 and -55

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On December 8, 2004, about 1031 mountain standard time,[1] a Cessna T207A, N1783U, operated by King Airelines, Inc., entered an uncontrolled descent and collided with mountainous terrain 28 nautical miles southwest of Meadview, Arizona. The weather-scouting flight was operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91,[2] and visual meteorological conditions prevailed in the vicinity of the accident site. The commercial pilot was killed, and the airplane was destroyed. The local flight departed Henderson Executive Airport (HND), Las Vegas, Nevada, about 1003.

A review of air traffic control (ATC) radar data revealed that, between 1020 and 1025, the airplane[3] made a series of turns while maintaining altitudes between 6,000 and 7,500 feet mean sea level and groundspeeds between 110 and 140 knots. About 1031, however, the airplane descended at a rate of about 4,000 feet per minute (fpm) then climbed at a rate of about 3,800 fpm before it disappeared from radar. Weather data for the area indicated no severe or unusual weather phenomena were present. The wreckage distribution at the accident site was consistent with a high-speed, vertical descent. With the exception of the inboard elevator torque tube, the rest of the airplane's right elevator, trim tab, and hinge pin were not identified at the accident site; extensive ground and aerial searches failed to locate these control surfaces.

[1] All times referenced are mountain standard time unless otherwise noted.

[2] Although King Airelines held a Part 135 operating certificate to conduct air tours, the accident flight was operated under Part 91. The purpose of the flight was for the pilot to determine the weather conditions in tour areas that did not have weather reporting capabilities. More information about the accident, LAX05FA046, is available on the National Transportation Safety Board's Web site at <http://www.ntsb.gov>.

[3] Because the flight was operated under visual flight rules with no flight-following services, the airplane was not assigned a discrete transponder code by ATC personnel. Mode C transponder returns were observed that corresponded with the accident flight's departure from HND and that subsequently disappeared from radar at a location consistent with the location of the accident site.

Maintenance records and interviews with company pilots identified previous instances of the airplane vibrating during flight. The first instance of vibration was reported several weeks before the accident, and the most recent instance of vibration occurred 2 days before the accident. In each reported instance, maintenance personnel were unable to determine the source of the vibrations.[4]

The airplane was manufactured in 1977 and was equipped with foam-filled elevator trailing edges and a foam-filled elevator trim tab.[5] A review of the airplane's maintenance records showed no evidence that the original elevators or trim tab had been replaced.

On April 14, 1997, the National Transportation Safety Board investigated an accident involving a Cessna 210D[6] that experienced an in-flight failure of the elevator trim tab, which resulted in a severe vibration and subsequent failure of the right elevator.[7] The airplane was equipped with a foam-filled elevator trim tab, which was corroded inside and had separated into two halves about midspan yet remained attached to the elevator by the piano-wire hinge pin. The trim tab actuator assembly was separated from the trim tab, and the right elevator was separated into two halves about midspan. The Safety Board determined that the probable cause of the accident was the "corrosion and subsequent failure of the elevator trim tab, which resulted in vibration and failure of the elevator. Failure of maintenance personnel to comply with a service bulletin was a related factor."

Background

More than 16,000 Cessna 206-, 207-, and 210-model airplanes manufactured between 1960 and 1986 were equipped with foam-filled elevator trailing edges and a foam-filled trim tab.[8] The intent of the foam-filled design was to provide rigidity within the clad aluminum

[4] Several weeks before the accident, a company pilot experienced a vibration during flight and reported the discrepancy to maintenance personnel. According to the pilot, the director of maintenance performed a test flight in the airplane and did not experience any vibration, and the airplane was returned to service. A discrepancy log entry dated November 14, 2004, stated, "Reported engine vibration at cruise," and a corrective action notation dated November 16, 2004, stated, "Noted 200 rpm drop. Repaired power ignition lead number 2 cylinder. Ground run check good." During interviews, three company pilots reported feeling a noticeable vibration during flight in the accident airplane, but they thought the vibration was due to the propeller or the engine, and they did not write up the discrepancy. Two days before the accident, the company pilot who had reported the airplane's previous vibration again experienced a vibration during flight; he logged the vibration in the airplane's post-flight inspection report, which was not reviewed by maintenance personnel prior to the accident flight.

[5] The airplane was serial number (S/N) 20700383, and the foam-filled trim tab was part number (P/N) 1234628-1. The trim tab is located on only the right elevator.

[6] The airplane, N3761Y, was S/N 21058261 and was manufactured in 1963.

[7] The two pilots on board that airplane initially thought the vibrations were the result of an engine problem until they observed the damaged elevator in flight. In spite of the damage, the pilot landed the airplane safely. More information about the accident, ATL97LA059, is available on the Safety Board's Web site at <http://www.ntsb.gov>.

[8] Specifically, the following airplanes were manufactured with the foam-filled elevator trailing edges and trim tab: Cessna P206, 1968 through 1969, S/N P206-0420 through P206-0603; Cessna P206, 1970, S/N P206000604 through P20600647; Cessna U206, 1968 through 1969, S/N U206-0915 through U206-1444; Cessna U206, 1970 through 1986, S/N U20601445 through U20607020; Cessna 207, 1969 through 1984, S/N 20700001 through 20700788; Cessna 210, 1960 through 1984, S/N 21057001 through 21064897; Cessna T210, 1966 through 1969,

structure and to help it retain its shape. The foam used was a combination of open- and closed-cell foam.[9] Unlike open-cell foam, closed-cell foam does not retain water, and the foam used in the components was sealed on the exposed edges and adhered to the aluminum skin. However, corrosion of the aluminum skin can release the seal and the foam behind it, enabling moisture to collect in the gap between the foam and the skin. This condition can potentially lead to even further corrosion and moisture retention.

Cessna Aircraft Company discontinued the manufacture of foam-filled elevator trailing edges and foam-filled trim tabs in 1985 after field reports of corrosion prompted an action for product improvement. Replacement elevator trailing edges and trim tabs are available for most of the airplanes that were originally equipped with foam-filled versions; the replacements utilize plastic spacers instead of the foam core.[10]

In 1985, Cessna issued Service Bulletin (SB) SEB85-7, "Elevator and Trim Tab Inspection," which recommends that, during routine inspections of the elevators and trim tab of certain 206-, 207-, and 210-model airplanes,[11] the inspections include a careful examination of the foam-filled elevator trailing edges and trim tab[12] for evidence of corrosion or foam deterioration. The SB recommends that the visual corrosion inspection be performed during the next 100-hour or annual inspection, whichever occurs first, and that "evidence of internal skin to foam separation, soft spots, paint blisters, unsealed edges of exposed foam, foam deterioration, or corrosion are cause for replacement of the assembly." The SB recommendations do not include control surface balancing for the foam-filled elevators. Maintenance records for the accident airplane showed no indication that maintenance personnel performed any corrosion inspections as recommended in SB SEB85-7, and they were not required to do so. The recommended actions outlined in a manufacturer's SB are not considered mandatory unless the Federal Aviation Administration (FAA) specifically requires them of the operator.[13]

S/N T210-0001 through T210-0454; and Cessna P210, 1978 through 1983, S/N P21000001 through P21000834. The foam-filled trim tabs were P/N 1234628-1 and P/N 12340007-7. The foam-filled left elevators are P/N 1234633-3, P/N 1234633-1, P/N 1234633-21, P/N 1234000-3, P/N 1234000-25, P/N 1234000-31, and P/N 1234620-3. The foam-filled right elevators are P/N 1234633-2, P/N 1234633-22, P/N 1234633-24, P/N 1234000-2, P/N 1234000-26, P/N 1234000-30, and P/N 1234620-4.

[9] According to Cessna, the components were made with mostly closed-cell foam and some open-cell foam. Closed-cell foam is a firm type of foam with varying degrees of hardness. Closed-cell foam provides more rigidity than open-cell foam, which is a more cushion-like type of foam that can retain water.

[10] The replacement trim tabs with plastic spacers are P/N 1234665-1, P/N 1234665-9, and P/N 1234665-10. The replacement trim tabs with P/N 1234665-1 and P/N 1234665-9 are the subject of a subsequent Cessna service bulletin (SB), SEB92-1, which recommends the installation of a doubler near the actuator attach bracket. The replacement trim tabs with P/N 1234665-10 are the subject of a subsequent Cessna SB, SEB00-6, which recommends the installation of additional rivets. For the 210-model airplanes, the replacement elevator trailing edges for those airplanes manufactured from 1960 through 1966, as well as the replacement trim tab for the those airplanes manufactured from 1960 through 1963, are filled with a different foam material designed to be more moisture-resistant than the original foam cores.

[11] The SB identifies, by serial number, the airplanes that were originally equipped with the foam-filled elevator trailing edges and trim tab.

[12] The SB identifies the foam-filled components as "elevator trailing edge and elevator trim tab;" it does not identify them by part number.

[13] The FAA does not mandate that Part 91 operators perform the actions recommended in SBs, but the FAA may require that some operators, including some Part 135 certificate holders, treat SBs as mandatory compliance

Because the right elevator and trim tab from the Cessna T207A involved in the December 8, 2004, accident were not recovered, there was no direct physical evidence that the accident was related to the corrosion issue. However, the fact that the right elevator, trim tab, and hinge pin were not found, combined with the unresolved severe vibration discrepancies and the highly unusual motions of the airplane before the uncontrolled descent, presents compelling evidence that these control surfaces separated in flight.[14] Such separations are consistent with corrosion-related problems associated with the foam-filled components, as was illustrated by the previously mentioned Cessna 210D accident in which the corroded elevator trim tab failed, resulting in the vibration and failure of the elevator.

On January 20, 2005, the FAA issued Special Airworthiness Information Bulletin (SAIB) CE-05-27,[15] which notes that the foam-filled elevator trim tabs "may soak up moisture, cause internal corrosion, and add weight to the tab, which could also lead to flutter."[16] In the SAIB, the FAA recommends the replacement of all foam-filled trim tabs with tabs that do not utilize foam and notes that, within the previous 5 years, Cessna had sold only 18 non-foam-type replacement tabs. The SAIB makes no recommendation regarding foam-filled elevator trailing edges. Compliance with the recommendations in the FAA's SAIB is voluntary, not mandatory.

Service Difficulty Reports and Other Data

A review of service difficulty reports (SDR) data clearly shows that moisture-related problems have continued to persist after SB SEB85-7 was issued. From 1973 to 2005, 47 maintenance SDRs were submitted regarding the foam-filled elevator trailing edges and trim tabs on Cessna 206-, 207-, and 210-model airplanes, which included reports of corrosion, vibration, control surface balance problems, and controllability concerns. The SDR data show that the foam cores of the elevator trailing edges and the trim tabs can retain moisture, which can cause internal corrosion of the skin and/or add weight to the affected cores. The moisture retention in the foam cores can alter the weight and the balance of the affected control surfaces; this problem, which could result in flutter and subsequent loss of control of the airplane, is not specifically addressed in the SB. The visual inspection for corrosion recommended in the SB would not be able to detect control balance problems related to internal moisture retention; such problems can only be detected by performing control surface balancing as outlined in the appropriate maintenance manual.

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items. Any such requirements would be specified in the certificate holder's operations specifications; King Airelines' operations specifications did not contain such a requirement. Cessna, however, considers its SBs, service news letters, supplier service notices, publications changes, revisions, reissues, and temporary revisions to be supplements and/or amendments to the approved maintenance manual for the applicable airplane(s).

[14] Separation of these control surfaces may not necessarily result in the loss of control of the airplane, as evidenced by the previously referenced April 1997 Cessna 210D accident in which the pilot landed safely after the right elevator failed.

[15] The FAA issued SAIB CE-05-27 as a result of information obtained by the FAA Aircraft Certification Office in early December 2004; it was not issued as a result of the December 8, 2004, accident involving the Cessna T207A.

[16] The SAIB states that, when the skin of the trim tab becomes thin due to corrosion, the actuator can pull the fasteners through the skin and disconnect, allowing the tab to flutter.

The Cessna Pilots Association (CPA)[17] Web site has a special section outlining the foam-filled elevator trailing edges and trim tab issues,[18] and the group states that it has seen numerous incidents of corroded elevator trailing edges and trim tabs and dozens more have been reported by its members. The CPA reports it has also seen elevators significantly out of balance limits due to corroded trailing edges and moisture retention. The CPA urges its members to consider the recommended inspections outlined in SB SEB85-7 as "must do" action items that should be performed recurrently at each 100-hour or annual inspection, and the CPA notes that the visual inspections require only minutes of labor. While the FAA's SAIB recommends the replacement of the trim tab, the CPA notes that regular inspections would help determine whether replacement, which would cost about $2,000 plus labor costs,[19] is necessary. In addition, control surface balancing, which is not addressed in the SB or SAIB, would require about 2.5 hours of labor.[20]

Conclusions

Moisture-retention problems in foam-filled elevators and foam-filled elevator trim tabs present serious safety issues that continue to persist despite the recommended inspections in the Cessna SB and the FAA's SAIB. The Safety Board is concerned that the persistence of problems, as identified through the SDR data, in the foam-filled elevator trailing edges and trim tabs shows that compliance with the nonmandatory SB[21] and SAIB has not been fully effective.

The Safety Board is also concerned that the inspections recommended in the SB are incomplete, as they do not include control surface balancing that could detect moisture-related weight and balance problems with the control surface that cannot be detected by the recommended visual inspection. The Board also notes that the SAIB addresses only the foam-filled trim tabs and fails to mention the elevator trailing edges. Moreover, although the SAIB recommends the replacement of all foam-filled trim tabs, recurrent visual inspections and control surface balancing may be a more cost-effective solution for operators.

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

> Require that operators of Cessna 206-, 207-, and 210-model airplanes that are equipped with foam-filled elevator trailing edges and/or a foam-filled trim tab inspect those foam-filled components for corrosion, perform an elevator control

[17] The CPA's membership comprises about 14,000 Cessna owners, pilots, and maintenance technicians.

[18] More information is available on the CPA's Web site at <http://www.cessna.org/public/foam/index.htm>.

[19] The cost of the trim tab can vary, depending upon the airplane model. Although the SAIB fails to mention the foam-filled elevator trailing edges, the replacement of entire elevators, if necessary, would cost about $9,300 for a left elevator and about $7,700 for a right elevator, plus labor costs.

[20] Labor hours are estimated according to information obtained from Cessna.

[21] As footnoted previously, the FAA does not mandate that Part 91 operators perform the actions recommended in SBs, but it may require some operators, such as some Part 135 certificate holders, to treat SBs as mandatory compliance items. Any such requirements would be specified in the certificate holder's operations specifications. Cessna, however, considers its SBs to be supplements and/or amendments to the approved maintenance manual for the applicable airplane(s).

surface balancing to ensure that the components are within the manufacturer's specified limits, and replace as necessary. (A-06-54)

Define a repetitive inspection program or terminating action for foam-filled elevator trailing edges and/or a foam-filled trim tab on the Cessna 206-, 207-, and 210-model airplanes that are so equipped. (A-06-55)

Chairman ROSENKER and Members HERSMAN and HIGGINS concurred with these recommendations.

[*Original Signed By*]

By: Mark V. Rosenker
Chairman