AVIATION OCCURRENCE REPORT
A99H0002

LOSS OF CONTROL AFTER TAKE-OFF

THUNDER AIRLINES LIMITED
BEECH AIRCRAFT CORPORATION A100 C-GASW
THUNDER BAY AIRPORT, ONTARIO
14 JUNE 1999

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The Thunder Airlines Limited Beech A100 King Air aircraft, serial number B108, took off at 1034 eastern daylight saving time (EDT) on a charter flight from Thunder Bay, Ontario, for Red Lake, Ontario, with two pilots and three passengers on board. After getting airborne, the aircraft pitched up to approximately 70 degrees, reaching a height estimated to be between 500 and 700 feet above ground level. It then rolled to the left, pitched steeply nose-down, and descended to the ground within the confines of the airport. The aircraft contacted the soft, level ground in a relatively level attitude and covered a distance of about 500 feet before coming to rest in a wooded area immediately beyond an elevated railroad bed and track. The cabin remained intact during the crash sequence, and all occupants escaped without any injuries. The aircraft was damaged beyond repair. An ensuing fuel-fed fire was rapidly extinguished by airport emergency response services (ERS) personnel.

Ce rapport est également disponible en français.

Other Factual Information

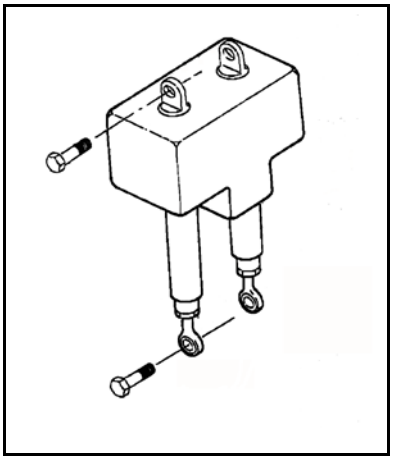
Records show that the pilots were certified and qualified in accordance with current regulations. They followed the procedures in the King Air 100 check-list and carried out all necessary verifications prior to and during the occurrence flight, including the control checks.

Reported weather at 1000 EDT (coordinated universal time minus four hours) was as follows: broken ceiling 3 400 feet above ground level, visibility 15 statute miles, and winds from 030 degrees true at 14 knots with gusts at 19 knots. All navigation aids at the Thunder Bay Airport were serviceable on the day of the occurrence with the exception of a degraded localizer front course, as identified in notice to airmen (Notam) No. 990231.

During take-off, at rotation speed, a clunk was heard by the co-pilot, and the aircraft immediately started to pitch up. The captain, the pilot-flying (PF), aided by the co-pilot, pushed forward on the control column, but the aircraft did not respond, and the climb could not be stopped. When the PF heard the stall warning horn, he selected the throttles to idle; the aircraft stopped climbing, rolled to the left, and pitched steeply nose-down. The crew pulled back on the control column to ease out of dive, but again the aircraft did not respond. As the aircraft was approaching the ground at an excessive rate of descent, the co-pilot pushed the throttles to maximum, and the nose of the aircraft started rising just before the impact.

Records show that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft was equipped with an emergency locator transmitter (ELT) Narco 10, serial number 40801, which activated and functioned normally until it was switched off by investigators. The aircraft was also equipped with a cockpit voice recorder (CVR) that was recovered and shipped to the TSB Engineering Laboratory for examination. The recording contained information useful in the investigation.

Thunder Airlines Limited maintenance personnel had performed work on the elevator and rudder controls during the weekend preceding the flight. In order to remove the rudder, the primary and secondary pitch trim actuators, connected between the stabilizer and the airframe, had to be disconnected from the airframe. This bracket, in the form of a double U, with the primary and alternate trim motors located in the middle, is attached to the airframe and the leading edge of the stabilizer. Four bolts are routed through the holes at each end of the actuators for attachment to the airframe and the stabilizer. After the occurrence, investigators found that the top of the actuators was not attached to the airframe. The two bolts did not pass through the actuator holes when reinstalled, only through the attachment holes in the airframe. When the bolts were tightened during installation, they squeezed the ends of the actuators to the attachment points on the airframe. Without the actuators attached to the airframe, the stabilizer was free to rotate to a full up or down position on its own.



Thunder Airlines Limited is an approved maintenance organization (AMO). The maintenance organization is small, and the workers know each other well. Their maintenance procedures manual (MPM) states that the aircraft certification authority is based on the employees' aircraft maintenance engineer (AME) licence issued by Transport Canada (TC). Canadian Aviation Regulation (CAR) section 573.05 outlines other requirements needed to be met to sign a maintenance release, and the associated training requirements are listed in CAR 573.06. The basic M4 licence allows maintenance personnel to sign off maintenance work on all light aircraft (under 5 700 kilograms), such as the King Air, including turbine-powered and pressurized models, without any formal courses and endorsements or any specified period of experience on aircraft type.

The AME who reinstalled the trim actuators received his AME licence about six months before the occurrence and had not previously worked on a stabilizer trim actuator. He was not briefed by the overseeing inspector (crew chief) before commencing the maintenance on the occurrence aircraft, nor was he supervised during the job. He did consult the maintenance manual, but only for the appropriate torque values. It is difficult to see the area where the bolts had to be installed, and much of the work was done by feel.

After the work on the aircraft was completed by the AME, the work was inspected by the day-shift crew chief, an employee that was considered to be a senior AME with about seven years' experience. He had worked on actuators in the past, but not in the previous three to four years. During the installation, the crew chief was holding the stabilizer while the AME was reinstalling the bolts. During the independent inspection, the crew chief looked at the work area from the right-hand side of the tail, through a round access panel. He could not easily see the area and did not use a mirror or other means to ensure that the work had been properly completed. The crew chief knew the AME who had performed the work and was confident in his ability. They performed a primary and alternate trim control check and observed that the stabilizer appeared to respond normally.

On 10 October 1997, TC published Airworthiness Notice (AN) C010, Edition 1, on Inspection of Control Systems. AN C010 explains the regulations applicable to maintenance of engine and flight controls and outlines the applicable standards for control system maintenance, especially for the second independent control check of control systems after maintenance. Both of the AMEs who worked on the occurrence aircraft had read AN C010.

The installation of the stabilizer trim actuator system on this aircraft is a relatively simple task. Experienced AMEs do not refer necessarily to service manuals for more than torque values for simple maintenance tasks. However, it is common practice for an inexperienced mechanic to read the appropriate section of the maintenance manual before attempting a task for the first time. The maintenance manual covers basic removal and installation of the actuator, but it does not cover all aspects of partial removal and installation of components. The underlying assumption is that the mechanic has knowledge sufficient to do the task and to use tools as required, or that the mechanic is under supervision of someone who has that knowledge, usually the crew chief.

Analysis

The actions of the pilots did not contribute to the accident, nor did the weather, navigation aids, or airport conditions. Apart from the improper installation of the bolts that attach the trim actuator mechanism to the airframe, there was nothing remarkable about the condition of the aircraft.

The AME who performed the work was qualified, but was inexperienced; he had been a qualified AME for about six months, and he had never worked on a stabilizer trim actuator installation. The crew chief who inspected the work had been an AME for about seven years, was experienced on the aircraft type, and had worked before on a stabilizer trim actuator installation, but not in the previous three to four years.

The crew chief did not brief or discuss the task with the AME before the work began. He did not approach the job until after it was started. The inspection of the system had to confirm correct assembly, locking, and sense of operation, as stated in CAR 571.10 and explained in AN C010. The inspection was carried out superficially without close inspection from inside the tailcone or using the tools, such as a mirror, which would be standard for this type of inspection. The crew chief trusted the AME who performed the installation and was complacent in his inspection; this is not unusual in smaller companies where workers know each other and are used to working together.

The AME did not use a mirror or other devices, such as a centring punch, to ensure the proper alignment of the bolts during the installation. After completing the maintenance work, the AME and the crew chief carried out a control check and the control surface behaved normally. During take-off, when the pilot pulled the control column aft for rotation, air loads on the stabilizer caused the improperly attached trim actuators to separate from the airframe, which made the noise heard by the co-pilot on take-off. The separation of the actuator from the airframe rendered normal control of aircraft pitch impossible, even though the control column was still properly attached to the elevators.

The tower controller observed the aircraft crash land and immediately dispatched ERS personnel to the crash site where they assisted the occupants as they were getting out of the aircraft. Just as they were all clear, a small, fuel-fed fire broke out. The fire was quickly put out with fire-fighting equipment.

Findings

1. The pilots were certified and qualified in accordance with current regulations.

2. The AMEs were certified and qualified in accordance with current regulations.

3. Records show that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

4. The stabilizer trim actuator's two upper mounts bolts, which attach the mounts to airframe formers, were not properly installed by the AME.

5. The crew chief inspecting the installation did not ensure correct assembly of the work.

6. Following installation of the stabilizer trim actuator, the AME and the crew chief performed a primary and an alternate trim control check, which showed that the trim system was operating normally.

7. The flight crew performed the required flight control checks as per the King Air A100 check-list before taking off.

8. Because the actuators were not properly installed, air loads on the stabilizer during take-off caused the stabilizer trim actuators to disconnect from the empennage.

9. After the actuators disconnected from the empennage, the flight crew had no control of the pitch attitude of the aircraft using normal flight control inputs.

Causes and Contributing Factors

The flight crew lost pitch control of the aircraft on take-off when the stabilizer trim actuators became disconnected because they had not been properly reinstalled by the AME during maintenance work conducted before the flight. The crew chief responsible for the inspection did not ensure correct assembly of the stabilizer trim actuators, which contributed to the accident.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Jonathan Seymour, Charles Simpson, W.A. Tadros and Henry Wright, authorized the release of this report on 23 December 1999.