

AVIATION OCCURRENCE REPORT

ELEVATOR TRIM TAB FAILURE

**CANADIAN AIRLINES INTERNATIONAL
BOEING 737-200 C-GCPS
VANCOUVER, BRITISH COLUMBIA 60 nm E
05 DECEMBER 1995**

REPORT NUMBER A95P0272

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 Canadian Airlines Boeing 737 (CDN 688) departed Vancouver, British Columbia, at 2036 Pacific standard time and was climbing through flight level 310 when the crew felt a severe airframe vibration. There were no other abnormal indications. The crew decided to return to Vancouver, and, as the aircraft slowed down in the descent, the vibration stopped. Moderate vibration was again experienced during the approach, with flaps extended, but an uneventful, normal landing was carried out with the emergency response services on standby. An examination of the aircraft revealed that a two-foot section of the right elevator trim tab (part number 65-73799-14) was missing.

Ce rapport est également disponible en français.

Other Factual Information

The elevator trim tab was 90 inches long and had 4 hinge points, approximately 27 inches apart, with the control horn at the inboard end of the tab, inboard of the first hinge. It was the section between the first and second hinge points that broke off and was not found. The remaining small inboard section of the tab, with the control horn, broke free from the first hinge and was held to the elevator only by the attachment to the control rod. The outboard section was still attached by the remaining three hinges. Marks on the hinges indicated that this section was probably oscillating rapidly through its full range of movement.

The technician who removed the remaining portions of the trim tab noted that a fluid had flowed from the trim tab after he had removed it. Based on the fluid's appearance and odour, he assessed that it was de-icing fluid. The aircraft had been de-iced in Winnipeg about 24 hours before the occurrence flight, and since then, had flown 9 flights and accumulated 11.2 flight hours.

The small inboard section of the trim tab that had remained attached to the aircraft was examined by the TSB Engineering Branch. The examination revealed that the fractures all had occurred in composite material; however, it was not possible to determine their origin. The orientation of the cracks suggested that the final break had progressed from the leading edge towards the trailing edge. The outer layers of the composite surface material had debonded from the honeycomb core. Examination of the debonded material revealed no evidence of weathering or deposits of airborne contaminants, indicating that the debonding had occurred recently. The longer, outboard section of the trim tab showed no evidence of debonding.

The trim tab had a total flight time of 40,254 hours and 26,754 hours since it was last overhauled. It had been last repaired in July 1993 and had flown 6,564 hours since that time. There were, however, some irregularities in the records of the last repair. The initial defect report indicated that the leading edge was cracked and corroded, and that there were several loose rivets on the inboard end. The loose fasteners were replaced in the repair, but the description of the remainder of the repair was unclear. The description indicated that the leading edge was repaired "...per structural repair manual (SRM) 51-40-3, Fig. 1", but this section gives general information on the repair of any formed section and does not supply information that is specific to the trim tab leading edge. It was not possible to determine from the records the nature of the repair, nor the areas of the tab which had been affected. The technician who had performed the repair was a sheet metal repairman. He was unable to recall the nature of the repair, but since he had not repaired composite structures before, it was assumed that the metal leading edge had been replaced, and that no repair had been performed on the composite structure.

The inboard portion of the trim tab was sent to the Boeing Aircraft Company for an examination to determine if there was evidence of an

improper repair. Their examination concluded that "...the materials are per drawing requirements and we see no indication of prior damage or repairs on the sample we examined." In addition, the Boeing report offered the opinion that the damage pattern was consistent with damage that occurred while the aircraft was on the ground, and that the damage reduced the trim tab's stiffness and would have allowed it to flutter to failure while the aircraft was in flight.

Transport Canada's service difficulty reporting (SDR) database recorded a number of incidents involving airframe vibration that resulted from worn elevator trim tab bearings. The occurrence trim tab bearings were measured for wear and were found to be within serviceable limits. The database did not record any instances of elevator trim tabs suffering structural failure. In addition, Boeing indicated that the elevator trim tab did not have a history of this kind of failure.

There were two trim tabs for the elevator; one on the left elevator and one on the right. The failure of the right trim tab did not endanger the aircraft from the standpoint of a loss of control; control surface flutter, however, can lead to further aircraft structural damage. The outboard section of the tab was attached to the elevator without any restriction to its movement, and it oscillated uncontrollably. This in turn caused the elevator to oscillate, which resulted in the airframe vibration felt by the crew.

During the course of this investigation, persons frequently expressed concern about the frequency with which aircraft were damaged by ramp vehicles. People operating ramp vehicles near aircraft are not always trained in the field of aviation, and consequently may not appreciate the critical nature of any damage to a flight control surface. The world's airlines estimate that the global cost of ramp accidents and incidents is about US\$2 billion per year, and the International Airline Transportation Association (IATA) has established a committee to examine this problem. Individual airlines, such as Canadian Airlines International, are also researching the problem and attempting to reduce ramp damage through employee education programs. Transport Canada sponsors an annual symposium dealing with maintenance and ground crew errors.

Analysis

Although the records for the 1993 repair to the trim tab were insufficiently detailed to determine the exact nature of the repair work carried out, there was no evidence that the repair work was incomplete or improper. There was no history of trim tab fatigue failure; the typical cause for flutter was worn bearings, and this possibility was ruled out in this occurrence.

The trim tab structural failure was a direct result of the in-flight aerodynamic loads exceeding the structural strength of the trim tab, which had been weakened by either recent or existing damage, spontaneous composite debonding and/or fatigue, or a combination of both.

The presence of de-icing fluid inside the trim tab indicated that the damage to the composite structure had likely occurred before the aircraft was last de-iced. The trim tab may have been originally damaged as a result of a collision with a ground vehicle or an airport structure, but such a collision could neither be substantiated nor ruled out. Given the nature of the mode of failure and the lack of other plausible explanations, however, such a collision being the initiating event for the trim tab failure is considered most likely.

The following Engineering Branch report was completed:

LP 191/95 - Elevator Trim Tab Examination.

Findings

1. A 24-inch section of the right elevator trim tab separated from the aircraft in flight.
2. The records for the July 1993 trim tab repairs were incomplete, but there was no evidence that the repair was improper.
3. Ground handling damage to aircraft is recognized as an aviation industry problem, and it is possible that the failure of the elevator trim tab was initiated by such damage.

Causes and Contributing Factors

The cause of the trim tab failure was not determined; however, the tab was most likely originally damaged in a collision while the aircraft was on the ground.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, Benoît Bouchard, and members Maurice Harquail and W.A. Tadros, authorized the release of this report on 27 August 1996.