

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A06O0104



IN-FLIGHT SEPARATION OF FLAP TAB

**EXPRESS NET AIRLINES
AIRBUS A300 B4-203 N372PC
TORONTO, ONTARIO
01 MAY 2006**

Canada

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.

Aviation Investigation Report

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Airbus A300 B4-203 N372PC
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Summary

The Express Net Airlines Airbus A300 B4-203 aircraft (registration N372PC, serial number 0196) departed Dayton, Ohio, United States, as Express Net Airlines Flight 137 (XNA137) on a cargo flight to Toronto, Ontario, with three crew members on board. At approximately 2130 eastern daylight time, while approaching Runway 05 at the Toronto/Lester B. Pearson International Airport, the flight crew disconnected the autopilot and the aircraft began to roll right. The roll was corrected with left rudder input and the aircraft landed without further incident. Once the aircraft was parked, ground crew advised the flight crew that the left centre inboard flap tab was missing from the aircraft. The separated flap tab was located in a retail parking lot at 2900 Argentia Road in Mississauga, Ontario. It had struck and significantly damaged an unoccupied parked vehicle. The parking lot was approximately 13 kilometres, or 7 nautical miles, from the airport on the Runway 05 approach path.

Ce rapport est également disponible en français.

Other Factual Information

The weather at the time of the incident was reported as visibility 10 miles, wind 100° magnetic at 9 knots, temperature 18°C, dew point 15°C and atmospheric pressure 30.20 inches of mercury.

The pilot-in-command (PIC) was seated in the left seat. He held a valid United States airline transport pilot licence, and his latest aviation Class 1 medical certificate was issued on 16 February 2006. As of 01 May 2006, the PIC had accumulated approximately 4681 total flying hours with 381 hours on type.

The second-in-command (SIC) was seated in the right seat. She held a valid United States airline transport pilot licence, and her latest aviation Class 1 medical certificate was issued on 16 September 2005. As of 01 May 2006, the SIC had accumulated approximately 6000 total flying hours and 2655 hours on type.

The flight data recorder (FDR) and cockpit voice recorder (CVR) were removed and sent to the Transportation Safety Board of Canada (TSB) Engineering Laboratory for analysis. There were no discernable anomalies during the take-off, climb, and cruise portions of the flight. At 2107:42 eastern daylight time,¹ the aircraft began the initial descent to the Toronto/Lester B. Pearson International Airport (CYYZ) from a cruising altitude of flight level (FL) 290.

At 2125:12, the flap lever was moved to the flap 10 position; the aircraft was at 5400 feet above sea level (asl) and 183 knots. At 2125:48, the flap lever was moved to the flap 15 position; the aircraft was at 4850 feet asl and 182 knots. At 2129:15, the flap lever was moved to the flap 25 position; the aircraft was at 2550 feet asl and 170 knots. At 2129:19, aileron and rudder movement increased significantly. It is estimated that this is when the left centre inboard flap tab separation occurred. The aircraft was approximately 2450 feet asl, 170 knots and 7 nautical miles (nm) from the runway threshold at this time. Less than one minute later (2130:06.5), the autopilot was disengaged, the heading began to increase to the right, and left rudder was applied to correct the heading. The remainder of the approach appeared to be stable and the aircraft touched down at 2132:15.25 at a maximum of 1.8 g.

¹ All times are eastern daylight time (Coordinated Universal Time minus four hours).

The left centre inboard flap tab is part of the trailing edge flap system (Figure 1). The flap tab is approximately 2.8 m (112 inches) long, 0.6 m (27 inches) wide and weighs approximately 16 kg (35 pounds). The main structural attachment, referred to as the flap tab hinge bracket (hinge bracket), was located mid span on the bottom of the flap tab near the leading edge. The hinge bracket is characterized as a solid lever that transitions to a box section for attachment to the inside of the flap tab.

Attachment was accomplished by a combination of PRC²-type sealant, rivets, and bolts. The

flap tab bottom skin, immediately around the hinge bracket, was covered by a doubler plate. The hinge bracket failed just below the bottom level of the doubler plate in line with the flap tab skin. As well, the flap tab was supported on the inboard end by a rod link and on the outboard end by a lever assembly (**Photo 1**). The inboard rod link was bent and had failed in overload. The outboard lever assembly was bent and the attachment ball bearing had pulled out of the ball bearing mount.

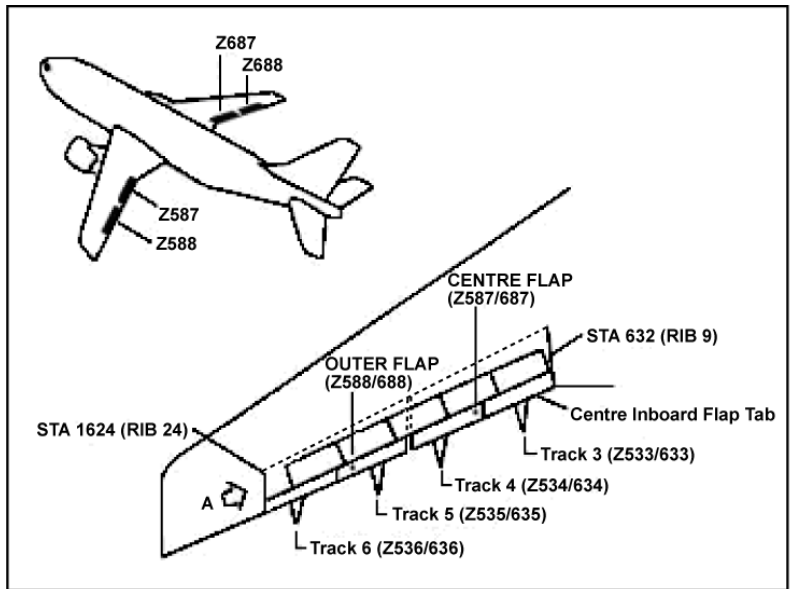


Figure 1. Overview of aircraft showing centre inboard flap tab position



Photo 1. Flap tab

A review of the aircraft's service history showed several discrepancies related to the flaps and flap tabs, but none were of any consequence and all would be considered normal in-service wear items, typical on any aircraft.

The flap tab and associated failed components, along with a worn lever from the right centre outboard flap tab, were sent to the TSB Engineering Laboratory for detailed examination. Representatives from Airbus and Stork Fokker (flap tab manufacturer) met with TSB

² PRC is a trademark of PRC DeSoto International, Inc., registered with the United States patent office.

investigators at the Engineering Laboratory to examine the failed components. Airbus has had problems with hinge brackets in the past, at the rear attachment lug, and on 05 August 1994, issued the following non-mandatory service bulletins (SBs):

- SB A300-57-0214 - Wings - Inspection of Inboard Center Flap Tab Hinge Bracket Assembly
- SB A300-57-0205 - Wings - Improved Inboard Center Flap Tab Hinge Bracket Assembly

The hinge bracket was improved by adding material to the rear attachment lug area. The previous operator of the incident aircraft had incorporated the improved brackets (SB A300-57-0205) on 27 December 1995 at a total airframe time of 27 495 hours and total airframe cycles of 23 518. Incorporation of the improved hinge brackets cancelled the need for the SB A300-57-0214 inspection. No discrepancies were noted in the installation paperwork available.

The improved hinge bracket failed at a total airframe time of 41 485 hours and total airframe cycles of 33 207. This equates to an installed time of 13 990 hours and 9689 cycles. The improved hinge bracket failed in a different location than previously identified and in less than half the time and cycles of the previously installed hinge bracket, which was serviceable when replaced. The hinge bracket failed in a location where visual detection of a crack would be very difficult, and some form of non-destructive test (NDT) inspection would be required to identify discrepancies in this area.

The flap tab and associated failed components, along with a worn lever from the right centre outboard flap tab, were sent to Stork Fokker in the Netherlands for hinge bracket removal and further examination. This examination was accomplished under the direction of the TSB with the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA), the Dutch Safety Board (DSB) and Airbus in attendance. All parts met the specified design criteria, and there was normal-to-severe in-service wear of the various attachment components that allowed for excessive play in certain areas.

Microscopic examination of the hinge bracket after removal from the flap tab showed that a fatigue crack initiated due to impact damage, measuring approximately 0.5 mm in depth. The impact damage was located at the outboard side of the flap tab hinge bracket in the contour radius at the transition hinge to flange. The fatigue crack propagated over 70 per cent of the cross-sectional area of the hinge bracket (Photo 2). The weakened hinge bracket, unable to sustain the increased aerodynamic flight loads with the flaps extended, failed as the crack length attained critical dimensions. The impact damage, at the origin of the crack, occurred in a location that is protected once the hinge bracket is installed.

The inboard rod link had failed in overload, and the outboard lever had bent and the ball bearing connecting the lever to the flap pulled out of the lever. The lever from the right outboard flap tab had excessive wear in the bushings and the wear was more pronounced than that of the left lever.

An examination of the corresponding flap tab from the right wing of the incident aircraft showed no significant abnormalities. Airbus was also able to obtain another set of inboard flap tabs from another aircraft and no significant abnormalities were noted on either of these two tabs.

There has been one other failure of this nature, in August 1991, on manufacturer's serial number (MSN) 170 aircraft (this aircraft was pre-modification SB A300-57-0205), and possibly one other on MSN 004 in November 1991. Due to parts being unavailable for testing, further investigation of these two incidents was not possible. The fleet of Airbus aircraft using this type of flap tab is indicated in the following table:

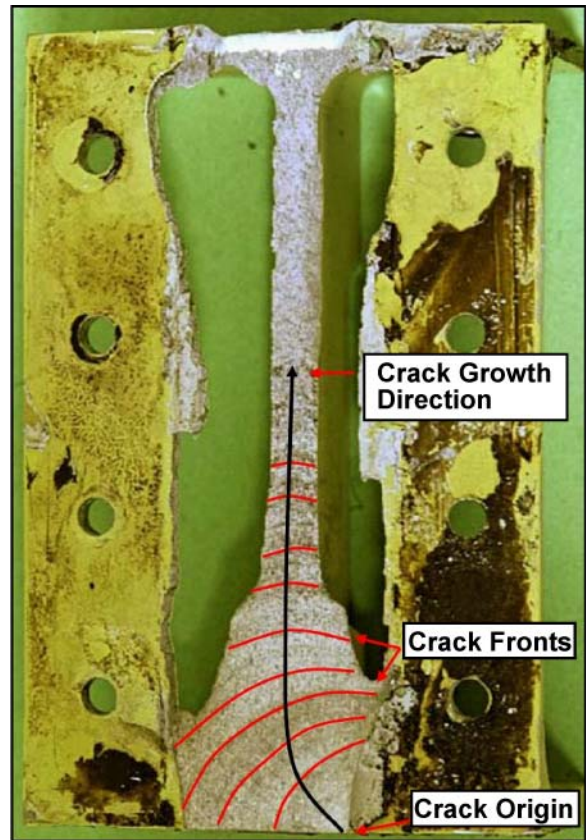


Photo 2. Hinge bracket fatigue pattern

Number of Aircraft in SB A300-57-0205 and A300-57-0214 Effectivity	240
Number of Aircraft Still in Service	119
Number of Aircraft Reported as Post SB A300-57-0214	89
Number of Aircraft Still in Service	49
Number of Aircraft Reported as Post SB A300-57-0205	17
Number of Aircraft Still in Service	7

Analysis

There were no abnormalities noted in the previous recorded flights or service history that indicated any problems with the hinge bracket before the incident. The hinge bracket failed due to low cycle fatigue, which originated at the site of the identified impact damage. The impact damage created a stress riser, which developed into a fatigue crack over the operating life of the hinge bracket. The impact damage was located in an area that is protected once the bracket is installed. It is likely that the hinge bracket was damaged before or during installation and, given the relatively small size of the damage, was likely not noticed at that time. After installation, it would not have been possible to see the damage, and detection of the crack during subsequent inspections would have been very difficult.

Airbus has positively identified one additional failure of this nature in a fleet of 240 aircraft incorporating this type of hinge bracket. Of the 240 aircraft produced, only 17 were reported to have incorporated the improved hinge bracket and only 7 of these remain in service worldwide, as of May 2006. Although it is possible that another failure of this nature could occur in the future, there were no adverse effects on the flying characteristics of the aircraft; therefore, the risk of a catastrophic event is low. However, it is unlikely that the hinge bracket will fail unless the flaps are extended for take-off or landing. Therefore, in the event of another failure, the aircraft would most likely be over a populated area.

The following TSB Engineering Laboratory reports were completed:

LP 033/2006 - Flap Tab Assembly
LP 034/2006 - FDR & CVR Analysis

These reports are available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. Hinge bracket damage, which occurred either before or during installation, created a stress riser for a low cycle fatigue crack to develop and progress over the life of the part.
2. The hinge bracket failed after the flaps were selected to the 25° setting while on approach to the Toronto/Lester B. Pearson International Airport. This allowed the flap tab to separate from the aircraft and strike a parked vehicle.

Finding as to Risk

1. Although in-flight separation of the flap tab presents little risk to the operating characteristics of the aircraft, the falling debris poses a risk of striking a populated area.

Safety Action Taken

Airbus is developing a repetitive inspection program (planned Inspection Service Bulletin [ISB] 57-0250) for the hinge bracket, and based on the results of that inspection program, will consider further modifications to the hinge bracket.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 23 October 2007.

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