



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 24, 2006

In reply refer to: A-06-27 and -28

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

On November 27, 2005, the rudder, part number (P/N) A55471500 (premodification 8827),¹ on an Airbus A300-600 airplane operated by Federal Express, N717FE, was damaged during routine maintenance. To assess the extent of the damage, the lower rudder rib was removed and the rudder was examined. In addition to the damage that occurred during maintenance, the examination found a substantial area of disbonding between the inner skin of the composite rudder surface and the honeycomb core.² A tap test inspection³ determined that a disbond of approximately 838 mm (33 inches) by 355 mm (14 inches), or 0.3 square meter (3 square feet), existed. Further examination of the disbonded area revealed traces of hydraulic fluid. Hydraulic fluid contamination between the honeycomb core and the fiberglass composite skin can lead to progressive disbonding, which compromises the strength of the rudder. Further tests on the damaged rudder revealed that a rapid propagation of the disbonding damage could occur during flight.

Background

On March 6, 2005, an Airbus A310-300, registration C-GPAT, operated by Air Transat as flight 961, experienced an in-flight separation of its rudder (also P/N A55471500 with the premodification 8827 configuration) shortly after departure from Juan G. Gomez International Airport in Varadero, Cuba. The flight was destined for Quebec Jean-Lesage International Airport, Quebec, Canada. While at an altitude of 35,000 feet, about 15 miles south of Marathon, Florida, the flight crew heard a loud bang followed by vibrations that lasted a few seconds. The

¹ Airbus identifies the configuration by which the rudder skin panels were attached to the front spar on some A300s and A310s, including the incident airplane, as premodification 8827. In this configuration, rivets penetrate the rudder's honeycomb core to join the rudder skin panels to the front spar. This configuration is identified as premodification 40904 when used on A330s or A340s. About 400 A-300 series airplanes were manufactured with the premodification 8827 or 40904 configuration before the rudder skin panel and front spar interface was redesigned. There are no A330s or A340s on the U.S. registry.

² The rudder surface consisted of a bonded honeycomb core between two composite skins.

³ During a tap test, an inspector taps the surface of a structure with a tool and listens for variances in sound to detect damaged areas.

flight returned to Varadero, where it landed uneventfully. Upon landing at Varadero, the crew discovered that most of the airplane's rudder had separated in flight with only the bottom closing rib and the spar between the rib and the hydraulic actuators remaining. Further examination of the vertical stabilizer determined that its two rearmost attachment lugs were damaged due to the high stresses associated with the rudder failure and separation.⁴ These high stresses may have been dangerously close in magnitude to those that caused the in-flight separation of the vertical stabilizer during the November 12, 2001, accident involving American Airlines flight 587.⁵ The Transportation Safety Board of Canada is investigating the accident with the assistance of accredited representatives from the United States National Transportation Safety Board and the Bureau d'Enquêtes et d'Analyses of France under the provisions of Annex 13 to the International Convention on Civil Aviation. The Air Transat accident investigation is ongoing and the cause of the accident has not been determined.

Following the Air Transat accident, on March 17, 2005, Airbus issued mandatory⁶ All Operators Telex (AOT) A300-55A6035 specifying a one-time rudder inspection for all A-300 series airplanes equipped with premodification 8827 or 40904 rudders. The AOT recommended that operators perform a tap test on the external surfaces of the rudder skin panels and spar in specific localized areas to inspect for disbonding damage. The AOT did not recommend that a tap test be performed on the inner surfaces. On March 28, 2005, the FAA issued Airworthiness Directive (AD) 2005-07-07, requiring operators to perform the inspections specified in the AOT. American Airlines and Federal Express (the only U.S. operators of these airplanes) complied with the AD.

Current Findings

When the rudder from the Federal Express airplane was sent to Airbus for further testing, investigators found that the areas specified in the AOT did not include the areas in which the disbonds were found on the incident rudder. Further, it was determined that tap tests on the external surfaces of the rudder likely would not have disclosed the disbonding of an internal surface. As a result of these findings, Airbus issued mandatory⁷ AOTs A300-55A6042, A310-55A2043, A330-55A3036, and A340-55A403, on March 2, 2006, notifying operators of applicable A-300 series airplanes that large disbonds between the rudder's inner skin and the honeycomb core could go undetected. The AOTs call for a visual examination, within 6 months or 500 cycles, for the presence of contaminant hydraulic fluids on rudder external surfaces and the performance of a manual tap test inspection at the inner side of the rudder panels. The AOTs indicate that the inspection takes about 2 hours to complete.

⁴ When the rudder separation began, the rudder started to flutter, or swing back and forth violently. This, in turn, led to the vertical stabilizer moving left and right and the stress in the lugs increasing to the point where the lugs became delaminated.

⁵ For more information on this accident, see National Transportation Safety Board, *In-Flight Separation of Vertical Stabilizer American Airlines Flight 587, Airbus Industrie A300-605R, N14053, Belle Harbor, New York November 12, 2001*, Aircraft Accident Report NTSB/AAR-04-04 (NTSB: Washington, DC, 2004).

⁶ The AOT was not regulatory but was mandatory per Airbus standards in that operators were required to comply to maintain the validity of their warranties.

⁷ As with AOT A300-55A6035, the March 2, 2006, AOTs were mandatory per Airbus standards but were not regulatory.

The AOTs further stipulate that if one disbond (per panel) is found but does not exceed 130 mm (5.1 inches) in diameter, then the panel should be reinspected or permanently repaired within 2,500 flight cycles. If one disbond (per panel) is found and is greater than 130 mm diameter but less than 200 mm (7.9 inches) diameter, a permanent repair must be performed before the next flight or an immediate temporary repair must be performed; the permanent repair must then be performed within 1,500 flight cycles. If a disbond exceeds 200 mm in diameter⁸ or if more than one disbond is found on one panel (even if no disbond exceeds 130 mm in diameter), the operator must immediately contact Airbus before the next flight with a detailed inspection report to obtain further instructions. The AOTs issued in March 2006, as well as AOT A300-55A6035 affect approximately 400 rudders worldwide. The accident and incident rudders from the Air Transat and Federal Express airplanes are premodification 8827 rudders and are the subject of the Airbus AOTs.

The examinations have also disclosed that hydraulic fluid can exist along the edges of the rudder's inner surface along with an accompanying area of substantial disbonding and that the inspection specified in the AOTs cannot detect the presence of the hydraulic fluid or the disbonding along the edges. Further, the migration rate of hydraulic fluid from the edges of the rudder's inner surface into the honeycomb core is unknown.

Although the Safety Board concurs with the procedures outlined in AOTs A300-55A6042, A310-55A2043, A330-55A3036, and A340-55A403 dated March 2, 2006, it is concerned that allowing an undetected hydraulic-fluid-induced disbond to exist for 500 flights, without supporting analysis or tests to better understand the safety risks, is unacceptable. Further, the Safety Board is concerned that some hydraulic fluid disbonds, when detected, would be allowed to exist for as many as 2,500 flights before the disbond is repaired. Rudder skin disbonds that are a result of hydraulic fluid contamination are particularly troubling because little is known about the progression rate once such disbonding is initiated. Contamination with hydraulic fluid will lead to a reduction in the bond strength and an overall loss in the rudder's structural integrity, as found on the Federal Express rudder, and leaves the airplane susceptible to the type of rudder separation experienced during the Air Transat flight. The consequences of a rudder separation include reduced directional control and possible separation of the vertical stabilizer.

The prevalence of hydraulic fluid leakage onto the surface of rudders throughout the A300-series fleet is unknown. The rate of growth of existing damage in the presence of this hydraulic fluid contamination is uncertain and currently unpredictable, and the resulting safety risks associated with the potential loss of the rudder or vertical stabilizer are severe. The Safety Board is aware that Airbus is considering exempting 24 aircraft from compliance with the current AOTs because, following the issuance of AOT A300-55A6035, these aircraft underwent additional nondestructive examinations. The Board is concerned that these tests may not have detected disbonds and that these aircraft should not be exempt from the current AOTs. The Safety Board is also concerned that there is a reasonable likelihood that disbonding damage similar to that found on the FedEx rudder, or worse, exists on other airplanes flying in the fleet today and that, given the uncertainty in the number of cycles to failure for composite rudders

⁸ The disbond area found on the rudder from the Federal Express incident airplane had a maximum length of more than 800 mm, which was well beyond this 200 mm threshold.

contaminated with hydraulic fluid, the safety risk over 500 additional flights is unacceptable. As a result, the Safety Board believes that the inspections specified in the AOTs should be conducted with the utmost urgency on all premodification 8827 rudders. Further, due to uncertainty about the migration rate of hydraulic fluid when it is present along the edges of the rudder's inner surface and the inability to inspect near the edges, the inspections specified in the AOTs should be conducted on more than a one-time basis to increase the likelihood of detecting any aggressive growth of damage that occurs in the presence of hydraulic fluid contamination. Therefore, the Safety Board believes that the inspections described in the March 2, 2006, AOTs should be initiated immediately, possibly before further flight, and repeated at a specified interval. Any necessary repairs should be accomplished as soon as possible, well before the 2,500 flights specified in the AOTs.

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

Require that all operators of Airbus A-300 series airplanes immediately comply, with Airbus All Operators Telexes (AOT) A300-55A6042, A310-55A2043, A330-55A3036, and A340-55A403 dated March 2, 2006. Any disbonding to the rudder skins that occurs in the presence of hydraulic fluid contamination should be repaired or the rudder should be replaced as soon as possible, well before the 2,500 flights specified in the AOTs. (A-06-27) Urgent

Establish a repetitive inspection interval for Airbus premodification 8827 rudders until a terminating action is developed. The interval should be well below 2,500 flights. (A-06-28)

Acting Chairman ROSENKER and Members ENGLEMAN CONNERS, HERSMAN, and HIGGINS concurred with these recommendations.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman