Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

REASSESSMENT OF THE RESPONSES FROM TRANSPORT CANADA TO AVIATION SAFETY RECOMMENDATION A06-05

INSPECTION PROGRAM OF RUDDER ASSEMBLY

Background

On 06 March 2005, an Airbus A310-300, serial number 597, registration C-GPAT, operated by Air Transat as Flight 961, departed Juan G. Gomez International Airport in Varadero, Cuba, for Québec/Jean Lesage International Airport, Quebec, with 2 pilots, 7 flight attendants, and 262 passengers on board. While the aircraft was in the early en route phase of the flight, a loud noise was heard, followed by vibrations. The aircraft then started a dutch roll motion. The crew was able to stabilize the aircraft once it had descended to a lower altitude. Following a discussion with the company, the captain decided to return to Varadero. On arrival at Varadero, it was discovered that the aircraft rudder was missing.

The rudder is made of composite sandwich construction, consisting of a nomex honeycomb core with carbon fibre face sheets. The rudder had separated from the aircraft except for its bottom closing rib and the length of spar between the rib and the hydraulic actuators. Only small residual amounts of rudder side panel remained attached.

Following the occurrence, other aircraft were inspected to evaluate the structural integrity of rudders in the fleet. In March 2005, Airbus issued an All Operators Telex (AOT) for the inspection of all aircraft equipped with part number A55471500 series rudders. This one-time visual and tap-test inspection involved 222 Airbus A310s, 146 Airbus A300-600s, 6 Airbus A330s, and 34 Airbus A340s, for a total of 408 aircraft. In addition, a more detailed inspection of rudder side panels on over 20 aircraft was conducted using the elasticity laminate checker (ELCH) test method. Finally, the attention drawn to rudders by the occurrence resulted in operators examining their rudders more closely during maintenance. These various inspections found examples of disbonds, damage around hoisting points and trailing edge fasteners of the rudder, corrosion and abrasion at hinges, seized hinges, hinges with excessive free play, water ingress, and hydraulic fluid ingress.

The findings of the fleet inspection suggest that the current inspection program may not be providing an adequate oversight for timely detection of defects and damages.

On 27 March 2006, the Board released interim safety recommendations as part of its investigation (A05F0047) into this occurrence.

Board Recommendation A06-05 (27 March 2006)

The separation of the rudder from Air Transat Flight 961 and the damage found during the post-occurrence fleet inspections suggest that the current inspection program for Airbus composite rudders may not be adequate to provide for the timely detection of defects. In addition, the recent discovery that disbonds could grow undetected and the increasing age of the composite rudders suggest that increased attention is warranted to mitigate the risk of additional rudder structural failures. The consequences of a rudder separation include reduced directional control and possible separation of the vertical tail plane.

Therefore, the Board recommended that:

> The Department of Transport, in coordination with other involved regulatory authorities and industry, urgently develop and implement an inspection program that will allow early and consistent detection of damage to the rudder assembly of aircraft equipped with part number A55471500 series rudders.
>
> A06-05

Response to A06-05 (14 June 2006)

In its 14 June 2006 letter, Transport Canada (TC) provided the following comments:

- TC concurs with the TSB suggestion that the current A310-300 inspection program may not be adequate to provide timely detection of defects to the rudder assembly. This may be caused by either inappropriate inspection intervals or inadequate inspection techniques.

- At the time of this occurrence, composite materials in general were, from a maintenance perspective, believed to have a no damage growth design philosophy. It was also believed that, from a fatigue point of view, more frequent inspections of composite materials would not prove to be more effective. In addition, these concepts were an industry-accepted philosophy during the development of maintenance programs using the Maintenance Review Board (MRB) process.

- As a result of this occurrence, and the additional findings based on the Airbus AOT, TC now believes that there is potential for damage growth. Following this determination, the Department inspected additional Canadian-registered Airbus A310-300 series aircraft in order to evaluate the effectiveness of the current Airbus maintenance program.

The following corrective actions are currently being taken by TC:

- TC will send a letter to Airbus Industries and the Direction Générale de l'Aviation Civile (DGAC) of France detailing the results of the additional inspection on a Canadian-registered Airbus A310-300 series aircraft.

- TC will recommend that a detailed inspection of the drainage path of the rudder for blockage be added to the current inspection program to ensure that there is adequate drainage.

- TC will request that Airbus Industries review the current inspection program for the vertical stabilizer and rudder assembly for the Airbus A300/A310 aircraft series.

- Because a tap test, a scheduled inspection of the rudder required at the time of the occurrence, is potentially not effective in determining smaller areas of delamination or disbond of composite materials, TC is currently working with the National Research Council of Canada to identify suitable inspection techniques that will detect failures in composite materials.

- To better identify failures in composite material, TC will coordinate with the International MRB Policy Board to review the logic used in developing maintenance programs.

Board Assessment of the Response to A06-05 (04 October 2006)

In its 14 June 2006 response, TC states that it is currently working with the National Research Council of Canada to identify suitable inspection techniques that will detect failures in composite materials. TC will recommend that a detailed inspection of the drainage path of the rudder for blockage be added to the current inspection program to ensure that there is adequate drainage. TC will also request that Airbus Industries review the current inspection program for the vertical stabilizer and rudder assembly for the Airbus A300/A310 aircraft series, and will work with the International MRB Policy Board to review the logic used in developing maintenance programs.

TC concurs that the current Airbus A310-300 inspection program may not be adequate to provide timely detection of defects to the rudder assembly; however, the response will not significantly reduce or eliminate the risk as stated in the recommendation in the short term, until the intended actions result in the development of an early and consistent detection program of any damage to the affected rudders. Consequently, the response is assessed as **Satisfactory Intent**.

Next TSB Action (04 October 2006)

The TSB will follow up changes in inspection techniques, maintenance, and research on detection programs. This deficiency file is assigned an A**ctive** status.

Response to A06-05 (07 February 2007)

In its letter dated 07 February 2007, TC provided the following comments:

- TC has made Airbus and the DGAC aware of the findings made on a number of Canadian-registered A310-300 aircraft, as part of the continuing AOT initiative.

- TC will, at the next scheduled A310/A300-600 Industry Steering Committee meeting, recommend to Airbus that a detailed inspection for blockage of the rudder drainage path be added to the current inspection program.

- TC will request that Airbus Industries continue to review the current inspection program for the rudder assembly for the A300/A310 aircraft series.

- TC will monitor the Airbus initiative to develop an ultrasound inspection technique to detect rudder skin disbond for repetitive application as part of the rudder inspection schedule.

- TC will be presenting an issue paper at the next International MRB Policy Board meeting. The paper will discuss the impact that composite material failures will have on the logic processes used in developing maintenance programs.

Board Reassessment of the Response to A06-05 (24 July 2007)

While TC's latest response includes actions previously reported to the TSB, it also contains new information, which demonstrates a continued support for the suggested course of action identified in Recommendation A06-05. Because the action plan, when fully implemented, will substantially reduce the safety deficiency identified in Recommendation A06-05, the assessment remains as **Satisfactory Intent**.

Next TSB Action (24 July 2007)

The TSB will continue to monitor changes in inspection techniques, maintenance, and research on detection programs. This deficiency file is assigned an **Active** status.

Response to A06-05 (06 March 2008)

In its response of 06 March 2008, TC provided the following comments:

- TC has made Airbus and the DGAC of France aware of the findings made on a number of Canadian-registered Airbus A310-300 aircraft, as part of the continuing AOT initiative, thus making it unnecessary to duplicate reporting by letter.

- TC has recommended and discussed with Airbus a detailed inspection for blockage of the rudder drainage path to be added to the current inspection program, to ensure that there is adequate drainage.

- TC has requested that Airbus Industries continues to review the current inspection program for the rudder assembly for the Airbus A300/A310 aircraft series. This is ongoing.

- TC will monitor the Airbus initiative to develop an ultrasound inspection technique to detect rudder skin disbond for repetitive application as part of the rudder inspection schedule. A repetitive inspection will be reviewed at the next Industry Steering Committee (ISC) meeting in 2008.

- Airbus Central Entity for Maintainability and Maintenance Engineering has confirmed that rudder ultrasonic inspection results are being reviewed to determine what actions affecting the aircraft inspection schedule need to be taken. TC will discuss progress made at the next ISC meeting in the second quarter of 2008.

Board Reassessment of the Response to A06-05 (13 August 2008)

In addition to TC's action taken, the European Aviation Safety Agency (EASA), on 08 October 2007, issued Airworthiness Directive (AD) 2007-0266 (Stabilizers - Vertical Stabilizer & Rudder Structure - Inspection/Repair for A310, A300-600 Aircraft), and on 14 January 2008, issued AD 2008-0012 (Stabilizers - Carbon Fiber Reinforced Plastic (CFRP) Rudder - Inspection/Repair for A330, A340-200/-300 Aircraft). These ADs demand more sophisticated inspection techniques than the original tap test; specifically, the inspections now require ultrasonic, thermography, and x-ray processes.

In addition, these ADs demand a mixture of new, one-time and repetitive inspections of areas where damages were found during the TSB investigation, and the periodicity of these inspections is not just based on somebody's best guess, but has been substantiated using knowledge of damage growth rates demonstrated by testing conducted during the TSB investigation.

TC's response not only addresses the specific course of action identified in Recommendation A06-05, but TC is taking significant supplementary action to address the longer-term risks of composite structure failures. TC's action taken has significantly mitigated the risks associated with the deficiency underlying Recommendation A06-05.

Therefore, this response to Recommendation A06-05 is assessed as being **Fully Satisfactory**.

Next TSB Action (13 August 2008)

No further action is required.

This deficiency file is assigned an **Inactive** status.