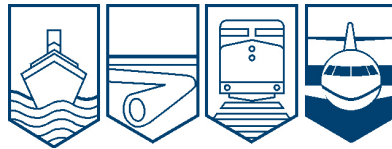


Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

**AVIATION INVESTIGATION REPORT
A10O0045**



CABIN SMOKE AND PASSENGER EVACUATION

**AIR CANADA
AIRBUS A320-211, C-FTJO
TORONTO, ONTARIO
23 MARCH 2010**

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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Air Canada

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Summary

An Air Canada Airbus A320-211 (registration C-FTJO, serial number 183), operating as Air Canada flight (ACA 433), departed Montréal/Pierre Elliot Trudeau International Airport, Québec, for Toronto/Lester B. Pearson International Airport, Ontario, with 98 passengers and 6 crew members on board. In cruise, 1 of the 3 hydraulic systems failed. The flight continued toward destination where, at 0844 Eastern Daylight Time, the flight made an uneventful landing. While stopped on the runway awaiting a tow, smoke entered the cabin and an evacuation was ordered. Two crew members and 2 passengers received minor injuries during the evacuation.

Ce rapport est également disponible en français.

Other Factual Information

History of Flight

The flight was scheduled to depart Montréal at 0730¹. As part of its pre-flight preparations, the flight crew performed an external inspection where nothing unusual was found. The aircraft logbook indicated that 6 litres of hydraulic fluid had been added overnight to the green hydraulic system. The entry included an instruction to monitor the quantity levels.

As per normal pre-flight preparations, the auxiliary power unit (APU) was started. Shortly thereafter, there was an odour in the cabin. Such odours are not uncommon and are often caused by engine washes or residue in the air conditioning system from the previous flight. The flight crew increased the cabin airflow and reduced the temperature. The smell soon dissipated and was not a problem for the remainder of ground operations. Shortly after takeoff, however, the odour returned. Again, the crew increased airflow and reduced the temperature; the odour dissipated.

While the aircraft was approaching the top of climb, the flight crew attempted to locate the source of the odour. At that time, the electronic centralized aircraft monitor (ECAM) system alerted the crew to a low reservoir level in the green hydraulic system. The ECAM actions were completed, which included turning off the hydraulic power transfer unit (PTU) and the green system engine driven hydraulic pump. The crew then verified these actions in the Quick Reference Handbook.

At that time, the flight was almost half way to Toronto, Ontario, where the weather was more favourable than in Montréal. A decision was made to continue to destination. Due to the green hydraulic system being de-energized, several systems were inoperative, including:

- nose wheel steering;
- normal brakes;
- normal gear extension; and
- number 1 (left) engine thrust reverser.

With systems inoperative, the aircraft would have to stop on the runway and be towed to the gate. The crew advised air traffic control and company maintenance. Aircraft Rescue and Firefighting (ARFF) was placed on standby. The crew briefed the passengers.

Following an emergency extension of the landing gear, the aircraft made an uneventful landing on runway 05 and came to a complete stop. Aircraft rescue personnel conducted an infrared and visual inspection; no anomalies were discovered. The flight crew started the APU, shutdown both engines and waited for company maintenance personnel and a tow vehicle to arrive.

¹ All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours).

The Evacuation

Company procedure calls for all passenger, cargo and service doors to be closed before towing an aircraft. The landing gear doors on the aircraft were open, as the green hydraulic system, which would normally close them, was de-energized. The tow vehicle operator asked that the gear doors be closed. Extension of the landing gear on approach caused hydraulic fluid to be returned to the reservoir, which was back in normal range. After conferring with maintenance personnel, it was decided to reenergize the green hydraulic system in order to close the gear doors. As such, the flight crew turned on the electric hydraulic pump and PTU.

Almost immediately, smoke began to enter the cabin and cockpit. Previous actions were reversed and the pump was turned off. Both left side passenger doors (L1 and L2) were disarmed and opened in an attempt to clear the smoke from the cabin. This did little to dissipate the smoke, as it continued to enter the cabin through the air vents. Passengers became uneasy and a few made their way towards the open doors. The service director stationed at the L1 door called the flight crew to inform them of the situation, whereupon the captain ordered an evacuation.

The cabin crew stationed at doors L1 and L2 closed the doors to rearm the emergency slides. All 4 doors were then opened and the slides were deployed. The passengers seated next to the 4 over-wing emergency windows opened their exits and the slides were deployed. The flight attendants commanded the passengers to leave everything behind and evacuate via the nearest exit; these instructions were also included on the passenger safety cards. Several passengers brought carry-on baggage and personal belongings to the exits. Some were again instructed to leave their baggage behind, while others were allowed to exit with their items to prevent blockage of the exits.

The evacuation was completed in approximately 2 minutes. As the evacuation progressed, the slides began to become damp from light rain. Two passengers who exited the aircraft with their baggage reported having received minor injuries, including scraped knuckles and sore backs. Two crew members, whose responsibilities required the carriage of emergency equipment, were the last to evacuate. They also hurt their backs exiting via the slide.

As the temperature was 3°C with light rain, the crew gathered the passengers together to await a bus to transport them to the terminal. Many passengers had taken their carry-on baggage because they were travelling on business and were concerned about the delay, while others were worried about making connections onto other flights.

Crew

The 2 flight crew and 4 cabin crew members were certified and qualified for the flight in accordance with existing regulations. All crew members had received adequate rest within the 72 hours preceding the incident.

Aircraft

Records indicate that the aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. The weight and balance were within the prescribed limits.

Maintenance checks the night before revealed the fluid quantity was low in the green hydraulic system. Maintenance personnel topped up the quantity and tested the system for leaks. No anomalies were found. Without an explanation for the fluid loss, maintenance made an entry in the logbook and raised the item to MONITOR status.

A post-flight inspection showed that a faulty yaw damper had leaked fluid, which had run down the sides of the aft fuselage and into the intake for the APU. The APU had compressed and heated the fluid, which was then sent through the bleed air system to the air conditioning pack, through the filters and eventually into the cabin.

The green hydraulic system, 1 of 3 such systems on this model of aircraft, runs several of the aircraft systems, including 1 of the 2 yaw dampers. The yaw dampers are relatively small, hydraulic actuators located in the lower aft portion of the vertical stabilizer.

Following the post-flight inspection, the number 1 or green yaw damper was sent for examination. The leak was due to degradation of the piston rod seals caused by a rough surface finish on the piston rod. This defect had been previously noticed by the manufacturer, and 2 non-mandatory Service Bulletins (SBs) were published, detailing modifications to address the problem (SC4700-27-26-02 Rev2 and SC4700-27-04). In addition, the manufacturer published a Service Information Letter (SIL 27-127), which outlines scheduled inspections of the yaw dampers to ensure their continued functionality. Although Air Canada completed the inspections as per the SIL, neither modification outlined in the SBs was made on C-FTJO, as the risk to safety was considered low.

The cockpit voice recorder (CVR) was recovered. However, it did not record the event, as it is designed to automatically stop 5 minutes after the last engine is shutdown. In this case, the shutdown occurred 16 minutes before the evacuation.

Carry-On Baggage

In 2007, the Transportation Safety Board issued a recommendation (A07-07) asking that Transport Canada (TC) require passenger safety briefings to include clear direction to leave all carry-on baggage behind during an evacuation. TC agreed with the recommendation and opted for regulatory change via the normal Canadian Aviation Regulation Advisory Council regulatory consultation process. At the time of this report, a draft regulation proposal had yet to be submitted. As this process can take in excess of 5 years, TC decided in the interim to publish a non-mandatory Advisory Circular (#700-012, 16 March 2009) reminding operators of the risks that may arise if clear direction to leave all carry-on baggage behind during an evacuation is not included in their passenger safety briefings. The Board assessed TC's response as "Satisfactory in Part".

At the time of the occurrence, Air Canada's pre-takeoff and pre-landing passenger safety briefings did not include this information. The company is currently implementing the recommendations in AC 700-012, with expected completion in 2011.

Analysis

As the loss of hydraulic fluid on the green system had already been noted in the logbook, it is likely that the yaw damper was the source of the previous leak. While no fluid leaks were noted during overnight maintenance or the flight crew walk-around, a small amount of residual fluid may have accumulated near the APU intake, which would account for the odour created during APU start. The odour noticed during climb may have been from the accumulation of particulates trapped in the air condition system filters.

Extension of the landing gear on approach caused a significant amount of fluid to be returned to the reservoir. This increase was sufficient to bring the reservoir quantity indication back into the normal range. Upon receiving the request to close the gear doors, the flight crew re-evaluated the status of the green hydraulic system and, noting no defects, reenergized the system. This caused high pressure fluid to leak from the number 1 yaw damper actuator. This fluid, now with no airflow to displace it from the aircraft, flowed down along the side of the fuselage into the APU intake. This caused smoke to enter the cabin. The flight crew disabled the pump and stopped the leak, but a quantity of fluid had already accumulated and continued to be ingested into the APU.

The L1 and L2 doors were disarmed and opened in an effort to provide some ventilation. The cabin crew opted to reclose and rearm the doors before evacuation. This did not, however, lead to a significant increase in the time it took to complete the evacuation.

Many passengers deplaned with their carry-on luggage. It could not be determined whether this was due to the fact that they were not aware of the instructions given by the flight attendants and included in the safety card, or if they were aware, but chose to disregard them. Passengers would have been more aware of this restriction if information was included during the pre-takeoff and pre-landing passenger briefings, as per TSB recommendation A07-07.

The few injuries that did occur may have been aggravated by the fact that the slides were wet from the rain, and the resultant speed of the exiting persons was higher than normal. While the baggage did cause some minor injuries and delays at the bottom of the slides, it did not appreciably increase the evacuation time. Were this a higher level of threat or emergency, however, even a slight delay could have resulted in more serious consequences.

TC agreed with the Board's recommendation (A07-07) that called for passenger safety briefings to include clear direction to leave all carry-on baggage behind during an evacuation. However, to date, no regulatory change has been implemented. Due to the extensive delay between TC's acceptance of this recommendation and the implementation of actual regulatory change, identified safety deficiencies continue to persist.

The following TSB Laboratory report was completed:

- LP032/2010 – FDR / CVR Analysis

This report is available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. A leak from the number 1 yaw damper caused fluid to be ingested into the auxiliary power unit and sent through the air conditioning system, resulting in smoke entering the cabin.
2. When the crew ordered the evacuation as a result of the smoke, several persons received minor injuries while exiting the aircraft via the emergency slides.

Finding as to Risk

1. Several passengers deplaned from the aircraft through the emergency exits while in possession of their carry-on baggage. This has the potential to increase evacuation time and risk of injuries, and possibly block emergency exits.

Other Finding

1. The extensive delay between Transport Canada's acceptance of this Board recommendation and actual regulatory change permits identified safety deficiencies to persist.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 March 2011.

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