Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

# AVIATION OCCURRENCE REPORT

# AIRCRAFT CONTROL DIFFICULTY

# AIR LABRADOR
# DEHAVILLAND DHC-8-102 C-GAAN
# ST. JOHN´S, NEWFOUNDLAND
# 28 APRIL 1998

## REPORT NUMBER A98A0055

Canada

# Aviation Occurrence Report

# Aircraft Control Difficulty

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## *Summary*

The DeHavilland Dash-8, Air Labrador Flight 1471 (LAL1471), departed St. John's, Newfoundland for Deer Lake at 0725 Newfoundland daylight time (NDT).[1] Immediately after take-off the first officer, who was the pilot flying, noticed excessive back pressure on the control column and unusually excessive pitch-up attitude. He trimmed the aircraft to counteract the back pressure, but even after moving the elevator trim control wheel to the full nose-down position the problem was still there. He informed the captain of the situation and the captain took control of the aircraft. The captain found that the elevator trim control wheel was jammed in the full nose-down position and, after levelling at 5,000 feet, he applied a heavy force to the trim control wheel to free it. Coincident with the freeing of the trim control the aircraft made a sudden nose-down pitching movement and the control column force returned to normal. The flight crew advised the Gander area control centre (ACC) of the situation and were given priority for a return to St. John's. The aircraft landed at St. John's at 0739 without further incident.

*Ce rapport est également disponible en français.*

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[1] All times are NDT (coordinated universal time minus two and one-half hours) unless otherwise noted.

# *Other Factual Information*

The aircraft had been hangered overnight in St. John's and had been brought to the terminal ramp at approximately 0515. When the flight crew carried out their initial inspection of the aircraft, they found that it was contaminated with a mixture of snow and ice. After boarding the passengers the crew taxied the aircraft to the de-icing bay, shutdown the engines, and had the aircraft de-iced. While taxiing from the de-icing bay to position for departure, an elapsed time of six to seven minutes, the only precipitation that the crew observed was light rain with some light snow mixed in. The pre-take-off control check did not reveal anything unusual, and the spoilers and the leading edge of the wings were found to be free of any contamination when they were visually inspected prior to the start of the take-off roll. The take-off roll was reported to be normal, but as soon as the aircraft was rotated, abnormal back pressure was felt on the control column and, as the aircraft accelerated the back pressure increased.

There had been several transmissions between the aircraft and Gander ACC before the captain asked for a return clearance to St. John's, and it was the ACC controller who asked the captain if he wanted priority, which he then requested and received. The captain indicated that the reason he did not ask for priority earlier was because he did not want to rush things, wanted to make sure the aircraft was under control, and wanted to try and find out what was causing the problem. There was also another aircraft on approach in front of LAL1471, and the captain felt that it would be too rushed to attempt to land in front of this aircraft.

Approximately 45 minutes after the aircraft landed back in St. John's, it was placed in a hanger where an inspection of the horizontal stabilizer and elevators revealed that they were contaminated with ice and slush. However, the crew reported flying through freezing rain on the return to St. John's and the aircraft was exposed to freezing rain while it was on the ramp prior to being placed in the hanger. An inspection of the complete elevator control system did not reveal any deficiencies. The aircraft was returned to service with no recurrence of the problem.

The weather observations in St. John's at the time of the incident was: indefinite ceiling 100 feet obscured, visibility one-half mile in light freezing rain and fog.

The organization that de-iced the aircraft before this flight was approved for this operation, and the crew operating the de-icing equipment were trained and qualified in accordance with Canadian Aviation Regulations, Part 622.11. The de-icing truck was positioned in front of the horizontal stabilizer with the boom and de-icing bucket extending out in front of the truck to a position that placed the de-icer about two feet above the horizontal stabilizer. It was determined that from this vantage point the de-icer was able to see the entire surface of the horizontal stabilizer and elevator.

The de-icing truck was properly equipped to apply de-icing fluid at the correct temperature and had adequate devices for the de-icing crew to monitor the temperature of the fluid being applied. The quantity used—670 litres of Type I de-icing fluid—was similar to the amount of fluid used by other de-icing companies that morning.

The Hold Over Table for Type I de-icing fluid shows that for the outside air temperature at the time of the incident and the type of precipitation, the time from last application of fluid to take-off should be in the range of two to five minutes. If the hold-over time has expired, take-off can be continued as long as the flight crew carry out a pre-take-off contamination inspection. The pre-take-off contamination inspection outlined in the company's operations manual for this type of aircraft calls for an inspection of the spoilers and the leading edge of the wing.

The first officer had applied full, nose-down elevator trim to counteract the back-pressure on the control column, and the elevator trim mechanism became jammed in this position. This condition has been addressed previously in DeHavilland Aircraft Safety of Flight Supplement, Number 1, dated 30 October 1992. The high breakout force applied by the captain to free the trim control is in accordance with the procedure described in this supplement.

Investigators applied full nose-down actuation of the elevator trim wheel while the aircraft was hangered. This resulted in a jammed trim control. The elevator trim tab actuators (pre-modification # 8/0509) were removed from the aircraft and replaced with another set (post-modification #8/0509). The same test was carried out with the replacement actuators installed and the trim control wheel jammed as before. In both cases, the trim could be freed using the procedure described in the DeHavilland Safety of Flight Supplement Number 1. The actuators that were removed were sent to the TSB Engineering Branch for analysis. The actuators were found to operate normally down to temperatures of -20°C. There is no mechanical stop in the trim tab system; the only stop is when the screw jack is at the extremes of travel. A simple analogy is installing a nut on a bolt and turning it until it bottoms out at the end of the thread cut.

The Dash 8 aircraft has a spring-tab mechanism to assist the pilot in operating the elevator (pitch) control surface. As the pilot moves the elevator in either direction to control the pitch of the aircraft, there is a considerable aerodynamic (slipstream) force on the surface and, therefore, considerable resistance to the pilot's input. Without some method to assist the pilot, it would be very difficult to operate this system. It should be noted that this is for relatively large aircraft, as the surfaces of lighter aircraft are easier to move. Various methods have been developed for this purpose, including the use of spring tabs. These tabs are situated on the trailing edge of the elevator and are mechanically linked to the elevator control through a series of levers and torque tubes. As the elevator is moved away from its central position, the tabs move in the opposite direction to assist the movement of the elevator, reducing the effort required by the pilot.

## *Analysis*

As no mechanical discrepancies were found that would explain the reason for the abnormal back pressure experienced by the crew, the analysis will focus on the effects of ice on the elevator control system and how and when the ice may have adhered to the control system in such a way as to affect the operation of the system.

When the First Officer rotated the aircraft for take-off by moving the control column aft, this action should have moved the elevator surface upward, and as air loads increased, caused the spring tab to move downward to assist in relieving control forces. If, however, the spring tab was

not moveable, then as the airspeed increased the pilot would feel a corresponding increase in backward pressure on the control column. A normal response to this pressure would be to use forward elevator trim to counter-act this force.

When control of the aircraft was transferred to the Captain, his response to the back pressure and full forward trim condition was to apply a high breakout force on the trim wheel. When the trim released, the control column moved abruptly and control of the aircraft was restored. This would indicate that the elevator spring tab movement obstruction was also removed.

Possible scenarios which could have caused this flight control obstruction were examined. In the absence of any evidence of mechanical failure or obstruction, and that the aircraft was operating in known icing conditions, the obstruction was most probably due to ice and/or frozen snow contamination. Icing of the elevator surface, elevator horns, and the effect of the weight of ice were also examined. None of these latter scenarios would present conditions similar to those experienced by the crew; consequently, it was concluded that the most probable scenario was that spring tab movement was restricted by an ice obstruction.

There are two possible explanations for there to be sufficient contamination to obstruct the spring tab movement. First, contamination was caused from freezing precipitation or snow after de-icing could have occurred; and/or second, not all ice or snow was removed during the de-icing process (it can be difficult for the de-ice operator to see between the elevator and the spring tabs because the trailing edge of the elevator tends to be pointed downward when the aircraft is stationary). It is unlikely that contamination subsequent to de-icing would be sufficient in itself to cause and obstruction to the spring tab movement; however, it could have exacerbated the residual ice or snow that may not have been removed during de-icing.

The following Engineering Branch report was completed:

LP 60/98 Elevator Controls Examination

# *Findings*

1. The elevator spring tab movement was restricted after take-off, probably due to an obstruction caused by an accumulation of ice and/or frozen snow in the gap between the spring tab and the elevator.

2. When full nose-down trim was applied to counteract the back-pressure on the control column, it jammed in that position.

3. The captain applied a high breakout force to move the elevator trim from the full nose-down position, in accordance with the procedure described in the DeHavilland Safety of Flight Supplement Number 1.

4. The captain did not ask for priority handling until prompted by the ATC unit and until after elevator control operations had returned to normal.

# *Causes and Contributing Factors*

The elevator spring tab movement was obstructed, probably by ice contamination, resulting in control column movement being restricted after take-off.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 08 January 1999.*