

Transportation Safety Board  
of Canada



Bureau de la sécurité des transports  
du Canada

## AVIATION INVESTIGATION REPORT

A00P0225



**LOSS OF AILERON CONTROL**

**CANADA JET CHARTERS LTD.**

**LEARJET 35A C-GDJH**

**VANCOUVER, BRITISH COLUMBIA, 30 NM NW**

**2 DECEMBER 2000**

**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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### *Summary*

The Learjet model 35A (C-GDJH) was on a medical evacuation flight from Vancouver to Terrace, British Columbia. After take-off, while climbing through flight level 290, the aircraft started turning right with 5 degrees of bank, although the autopilot was engaged and there was no reason for such a turn. The autopilot was disengaged, and the ailerons were immovable. Various control inputs were unsuccessful in getting the ailerons to move, and the right bank increased to about 20 degrees. There was no imbalance in the fuel contents. Air Traffic Control was advised of the control difficulties, and the control malfunction checklist was consulted. After four or five attempts to move the ailerons, there was a small movement and the angle of bank reduced to about 15 degrees. Continuing applications of force to the ailerons resulted in further movement until full aileron control returned. The aircraft had turned approximately 215 degrees to the right by that time. The aircraft returned to Vancouver. The descent and approach were normal, and the aircraft landed without further incident.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

Prior to the occurrence, the aircraft was on standby for a medical evacuation flight. It was fuelled and parked outdoors for several hours during a period of heavy rain. The surface temperature was 8 degrees Celsius, and the freezing level was approximately 5000 feet. After take-off, the autopilot was engaged as the aircraft climbed through flight level 180.

Because of the nature of the malfunction and the environmental conditions, and because the malfunction cleared up in the air, freezing of the controls was suspected. The aileron brush seals were examined by Canada Jet Charters maintenance personnel shortly after the aircraft landed. Excessive amounts of water and traces of ice were observed in the brush seals. The seals were cleaned, dried and re-lubricated. The aircraft was re-examined two days after the incident; the brush seals were visibly worn and matted, and some of the drainage channels were distorted.

A review of service difficulty reports and information from Bombardier/Learjet indicated that incidents of aileron control problems on all models of Learjet aircraft occur approximately once a year. In all cases, the airplanes had been thoroughly soaked with water before or just after take-off, and subsequently climbed into freezing conditions. Frozen aileron brush seals were suspected as being causal in these occurrences.

Brush seals are fitted to Learjet 35A ailerons to prevent aileron buzz at high mach numbers. When these seals become worn and matted, the channels, positioned about every 1½ inches, lose definition and no longer allow the free passage of water. On the occurrence aircraft, these seals were worn. Canada Jet Charters maintenance procedures called for the seals to be cleaned with a dry, clean cloth, and then lubricated with a silicone-based grease every 300 hours. The practice was to be generous with the grease. The Learjet 35A maintenance manual cautions against excess greasing since it may block the drainage channels, but it gives no indication of the amount of grease that would constitute an excess. As well, the maintenance manual does not establish criteria for the replacement of worn or damaged seals.

Experienced Learjet 35A aircraft pilots are aware that any time a take-off and climb into freezing temperatures is made after the aircraft has been exposed to rain, the risk of freezing ailerons can be reduced by hand flying the aircraft so as to keep the ailerons in motion as much as possible. While the possibility of frozen ailerons is mentioned in the *Pilot's Operating Manual*, the control malfunction checklist does not specifically address the condition of frozen ailerons.

The Learjet 35A maintenance manual does not specify any inspections or checks to be carried out on the aileron control system's integrity following an occurrence where extraordinary forces had to be applied to restore movement to the ailerons.

## *Analysis*

Based on the water and ice found in the brush seals after the aircraft landed, and the manner in which the ailerons froze and then became free in flight, it is concluded that water collected in the aileron brush seals while the aircraft was on the ground and subsequently froze, effectively freezing the ailerons, when the aircraft climbed above the freezing level. Wear and matting of the seals, and perhaps too much grease, affected the seal channels so they failed to allow the free passage of water, which then froze in place. Because there is little guidance for aileron brush seal maintenance, attention was not paid to the wear, and there was a lack of understanding as to the effects of over-greasing. An excessive amount of grease may have contributed to blocking the channels, thereby limiting the free passage of water.

## *Findings as to Causes and Contributing Factors*

1. Water became trapped in the worn and matted aileron brush seals and froze during flight, resulting in a loss of aileron control.

## *Findings as to Risk*

1. An excessive amount of grease may have been used on the brush seals, which would increase their risk of water retention in the seal channels.
2. While the Learjet maintenance manual did give some guidance as to brush seal maintenance, it did not address the issues associated with worn or damaged seals nor did it provide an objective definition of what constitutes over-greased or properly greased seals.
3. While the Learjet pilot's operating manual mentions the possibility of frozen aileron brush seals, it gives no advice on pilot recovery action, and the Learjet 35A control malfunction checklist does not specifically address the issue of frozen aileron brush seals.

## *Other Findings*

1. The possibility that the aileron control system could be damaged while applying abnormal aileron control forces (in an attempt to break free frozen brush seals) is not addressed in the aircraft's operating or maintenance manuals.

## *Safety Action Taken*

As a consequence of this occurrence, Canada Jet Charters reduced the lubrication interval from 300 to 100 hours.

Because of this investigation, Bombardier is taking action to reduce the possibility of recurrence. The maintenance manual procedures for all model Learjet airplanes are being revised to include inspection criteria for worn or damaged seals and more complete lubrication instructions. An article will appear in the upcoming issue of *Infoservice*, a Bombardier customer newspaper, which will emphasize the importance of proper brush seal maintenance. This article will appear in future newsletters semi-annually.

On 7 May 2001 the TSB issued an Aviation Safety Information Letter to Learjet Inc. regarding the following:

- the amount of grease to be applied to the brush seals;
- the possibility that wear and damage to the brush seal matting will restrict drainage of water from the seals;
- damage to the seals that could be caused while pilots are using force to break free controls that have frozen; and
- possible amendments to the operating manual regarding conditions that lead to frozen seals, prevention, and procedures in event the ailerons freeze.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 3 October 2001.*