

**INCIDENT**

<b>Aircraft Type and Registration:</b>	DHC-8-311, G-BRYW, and others	
<b>No &amp; Type of Engines:</b>	2 Pratt & Whitney PW123 turboprop engines	
<b>Year of Manufacture:</b>	1997	
<b>Date &amp; Time (UTC):</b>	28 September 2005 at 0829 hrs	
<b>Location:</b>	En route: Aberdeen to Manchester	
<b>Type of Flight:</b>	Public Transport (Passenger)	
<b>Persons on Board:</b>	Crew - 4	Passengers - 17
<b>Injuries:</b>	Crew - None	Passengers - None
<b>Nature of Damage:</b>	None	
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence	
<b>Commander's Age:</b>	38 years	
<b>Commander's Flying Experience:</b>	4,379 hours (of which 1,207 were on type) Last 90 days - 130 hours Last 28 days - 41 hours	
<b>Information Source:</b>	Aircraft Accident Report Form submitted by the pilot	

**Synopsis**

The aircraft experienced a restriction of the elevator nose down trim control in the cruise. This was one of a number of similar occurrences of pitch trim restrictions on the operator's DHC-8 fleet. The operator has since increased the frequency of lubrication of the elevator trim screwjacks, in accordance with recommendations published by the aircraft manufacturer.

**History of the flight**

The aircraft, which was being hand-flown because of an unserviceable autopilot, was on a scheduled passenger transport flight between Aberdeen and Manchester. In the cruise at FL230, the commander, who was the handling pilot, found that he could not move his elevator trim hand wheel forward of its current

position. It could be moved in a rearward direction and then forwards, but only as far as its initial position. When the Quick Reference Handbook (QRH) drill for an elevator manual trim failure was actioned, it was found that the standby electric trim system<sup>1</sup> would not move the elevator pitch trim wheels in either direction. The out of trim forces were, however, manageable and the flight was continued to its destination. As the aircraft descended through FL150, the manual elevator trim operation improved, allowing some nose down trim input.

**Footnote**

<sup>1</sup> The standby electric trim allows the elevator trim to be controlled electrically via the autopilot elevator servo.

Later examination of the aircraft did not identify any obvious defect that might have caused the incident; however, as a precaution, the trim screwjack actuator drive chains were cleaned and lubricated.

### **Elevator trim system description**

The elevator trim (or pitch trim) is controlled via two trim tabs, one at the outboard trailing edge of each elevator. In normal operation, the position of the trim tabs is controlled manually, via the captain's or co-pilot's trim hand wheels located on the centre console. The trim hand wheels are mounted on a common shaft and are connected to the trim tab screwjacks, one for each tab, by a series of cables and pulleys. Forward movement of the trim hand wheels provides nose down trim and rearward movement nose-up trim.

Movement of the trim hand wheels is transmitted through the cables and pulleys, to provide a rotary input to each screwjack, via a chain driving a sprocket on the input end of the actuator. The output side is connected to the trim tab by a fixed length push rod and idler assembly. Depending on the direction of the input command, the screwjack will either extend or retract, causing the trim tab to move up or down.

An elevator trim tab position indicator is mechanically operated by and located alongside, the captain's elevator trim hand wheel.

A standby elevator trim system is provided to maintain trim tab control in the event of a trim cable break occurring forward of the elevator trim servo location in the rear fuselage. In this mode, elevator trim is commanded electrically to drive the autopilot elevator trim servo. The standby elevator trim system is armed by selecting a guarded switch on the pilot's side console to 'ARM'. Elevator trim may then be controlled by either

of two spring-loaded trim switches, one on the pilot's side console and one on the co-pilot's side console.

### **Other similar occurrences**

The operator had experienced a number of other similar events on other aircraft in its DHC-8 fleet, which were reported to the AAIB. These incidents are briefly described below, and are identified by the date of the incident, aircraft registration code and the sector flown:

#### 17 November 2005 - G-NVSA, MAN-ABZ

When passing FL170 in day visual meteorological conditions (VMC), with a static air temperature of -3 °C, an 'ELEVATOR MISMATCH' annunciation appeared. The autopilot was disconnected and the QRH drill for an elevator manual trim failure actioned, whereupon the standby electric trim system was found to be inoperative. As the out of trim forces were not excessive, the autopilot was re-engaged and monitored by the crew. The pitch trim response returned to normal after the aircraft had levelled out. Subsequent inspection of the aircraft revealed the presence of water in the elevator trim screwjacks.

#### 12 November 2005 - G-NVSA, ABZ-MAN

When passing FL190 in day VMC, a 'NOSE DN PITCH MISTRIM' annunciation occurred. It was found that the elevator trim hand wheels could not be moved in a forward direction, but rearward movement was available. When the autopilot was disconnected, the standby pitch trim was also found to be inoperative. The pitch trim returned to normal at FL090 (the approximate freezing level), after which the autopilot was re-engaged. Engineering inspections of the aircraft revealed the presence of hardened grease in the

elevator trim mechanism. This was cleaned off and the pitch trim screwjack chains and sprockets re-lubricated.

#### 01 October 2005 - G-NVSA, GLA-MAN

Following reports of the elevator trim being stiff to operate in flight, the elevator trim screwjacks were cleaned and re-lubricated.

#### 27 September 2005 - G-NVSA, EDI-MAN\*

When leaving FL090 for descent to the cleared FL080 in day VMC, the autopilot failed to adjust the pitch trim. When the autopilot was disconnected, the aircraft pitched sharply nose-up. It was found that the elevator trim hand wheels could not be moved forwards, but rearward movement was possible. The aircraft was then hand-flown, with moderate effort required to maintain the required pitch attitude. The pitch trim operation returned to normal around FL080, where the static air temperature was approximately -3°C. Engineering inspections did not highlight any pitch trim system faults. However, as a precaution, the autopilot servo and elevator trim screwjacks were cleaned and re-lubricated.

#### 30 July 2005 - G-NVSB, EDI-MAN

At FL200 in day instrument meteorological conditions, a 'NOSE DN PITCH MISTRIM' annunciation occurred. When the autopilot was disconnected, the elevator trim hand wheels would not move in the 'nose down' (ie forward) direction, although 'nose-up' trim selection was available with difficulty. When the QRH drill for elevator manual trim failure was carried out, the standby nose down pitch trim was found to be inoperative. The pitch trim operation reverted to

normal after exiting icing conditions. The elevator trim screwjacks were subsequently lubricated. The last lubrication of the screwjacks had been 395 flying hours previously.

#### 14 July 2005 - G-BRYX, SOU-MAN

When passing FL101 at 230 KIAS in day VMC, a 'NOSE DN PITCH MISTRIM' occurred with the pitch trim jammed in a nose down setting. When the autopilot was disconnected, the elevator trim hand wheels were found to be stiff to operate. The elevator trim screwjacks were lubricated after the incident.

#### 05 July 2005 - G-BRYX, MAN-GLA\*

Passing FL150 in day VMC, a 'NOSE DN PITCH MISTRIM' annunciation occurred. When the autopilot was disconnected, the elevator trim hand wheel could not be moved in a 'nose down' sense, but 'nose up' trim was available. When the QRH procedure was carried out, the standby nose down pitch trim failed to operate. This flight and the previous three flights had reportedly been in very wet and icy conditions. Following the incident, the elevator trim screwjacks were lubricated, during which some moisture contamination was found in the right-hand elevator trim actuator.

\* These two incidents were included in a previous AAIB Bulletin EW/C2005/03/09, issued in April 2006, as they were believed to have been caused by the freezing of rehydrated residues of thickened de/anti-icing fluids. (Such residues are a common cause of control restrictions on aircraft with non-powered flight controls.) However, on reviewing the incidents, it is more likely that they were attributable to the freezing of moisture in the elevator trim screwjacks.

### Elevator trim actuator modifications

In-service operation of the DHC-8 has shown that the elevator trim screwjacks can accumulate water internally, which can freeze at altitude, causing a restriction in the elevator trim system. This led to modifications 8/0415 and 8/0569 being issued, to add a drain hole and install a grease fitting on the screwjack, respectively. Modification 8/0415 was mandated by the United States Federal Aviation Administration (FAA) under Airworthiness Directive 86-25-03.

### Manufacturer's advice to operators

The incidents listed in this bulletin occurred to aircraft which were fitted with modified elevator trim screwjacks. Service experience has shown that this type of screwjack can still be susceptible to moisture ingress, which freezes, causing elevator trim restrictions in flight. The problem can usually be eliminated by more frequent greasing.

The aircraft manufacturer, Bombardier Aerospace, recommends greasing at a 'C' Check, which has an interval of 5,000 flying hours. Recognising that some operators have continued to experience problems, the manufacturer provided the following advice to operators in 'Dash 8 In Service Activity Report Article 2005-09-2730', issued in October 2005:

*'Operators continue to report in-flight elevator trim screwjack freezing.*

*In accordance with the MRB Report (PSM 1-8-7) and the AMM, lubrication of the elevator trim screwjacks is at the 'C' Check interval. The environment in which an aircraft is operating may dictate a more frequent inspection and lubrication schedule. AMM 12-20-00 and MTCM 2730/04 are currently being revised (Temporary Revisions to follow). In the interim, Operators are encouraged to perform the following:*

*Lubricate the elevator trim screwjack while moving the elevator trim control through its full range of movement. Continue this lubricating process until clean grease (moisture-free) is observed to be expelled from the drain hole. After lubrication servicing, cycle the elevator trim screwjack through its full range of movement a minimum of fifteen times to remove excess grease. After completion of the lubrication task, close and seal the access panels.*

*CAUTION: Failure to remove the excess grease may result in excessively high loads required to move the elevator trim screwjack at low temperatures.'*

The operator has since increased the lubrication frequency of its elevator trim screwjacks in accordance with this advice.