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AIB Bulletin 6/86

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This Bulletin contains facts relating to the accidents which have been determined up to the time of issue. This information is published to inform the public and the aviation industry of the general circumstances of the accidents at the preliminary/stage and must necessarily be regarded as tentative and subject to alteration or correction if additional evidence becomes available.

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Aircraft type and registration:	HS 748 G-BCOF
No & Type of Engines:	Two Rolls-Royce Dart turbo-prop engines
Year of Manufacture:	1975
Date and time (GMT):	10 March 1986 at 1215 hrs
Location:	Approximately 15 nm northwest of Inverness Airport, Scotland
Type of flight:	Scheduled public transport
Persons on board:	Crew — 3 Passengers — 17
Injuries:	Crew — None Passengers — None
Nature of damage:	Bottom rudder hinge failed, resulting in further damage to the rudder control and its locking mechanism
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	48 years
Commander's total flying experience:	10,550 hours (of which 1600 were on type)
Information Source:	AIB Field Investigation

The aircraft was engaged on a scheduled public transport flight from Stornaway to Inverness with a crew of 3 and 17 passengers on board. After a normal take-off, climb and cruise at 11,500 feet, during which no adverse weather conditions or turbulence were encountered, it was cleared for descent and an approach to Inverness Airport. As the aircraft was descending at 225 knots in clear weather through 7,000 feet, the flight crew report that there was a sudden and violent oscillation in roll and yaw, which commenced with a roll to the right. The oscillations continued through about 5 cycles. The aircraft commander, who was the handling pilot at the time, reduced airspeed to about 160 knots and regained control to maintain wings level descending flight. The approach and landing at Inverness were completed without further incident. The aircraft was fitted with both a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR). The read out of the FDR failed to reveal either the magnitude or the frequency of the oscillations described by the flight crew. This was probably due to the speed of the event in relation to the sampling rate of the equipment. However, the crew comments recorded on the CVR revealed that the sudden excursion from controlled flight was coincidental with the disengagement of the automatic pilot.

During the immediate after-flight inspection it was apparent that, with the gust locks engaged, the rudder was not in its normal central position. A closer examination revealed that the rudder's bottom hinge, (the bottom one of three), had failed, allowing about 1 cm of free movement in that area. The damage was found to be consistent with the rudder, at some time, having been slammed onto its right side stops whilst the gust locks were not engaged. Fretting marks and wear on the damaged structure showed that the damage had been present for some time.

The aircraft's technical documents recorded that it had been repaired in mid-January 1986, following the discovery of similar but more severe damage to the rudder. No evidence of any defect in the repaired structure was found which could have contributed to the incident on 10 March 1986. However, between 3 February 1986 and 7 March 1986 there were several entries recorded by pilots in the technical log, referring variously to 'in-flight vibration', 'the auto-pilot applying excessive right rudder trim', and 'difficulty in engaging the gust locks'. As a result of these reports the aircraft was inspected and various remedial actions taken. However, as there was no consistency or apparent pattern in the reported defects nor any reports of vibration through the controls, a detailed inspection of the rudder was not carried out until after the incident on 10 March 1986. Detailed examination has shown that the spring strut connecting the rudder to the gust lock and stop system was serviceable and capable of performing its function as a shock absorber. The hinge failure had occurred under a single overload, and had resulted, most probably from strong lateral wind loads when the gust locks had been dis-engaged.

The freedom of the rudder to move at the bottom hinge could well have produced control effects which could explain both the 'in-flight vibration' and the 'excessive application of right rudder trim' applied by the autopilot. The rudder had freedom to move rearwards at the bottom hinge by about 1 cm. With a fixed pilot input this would cause a servotab movement to the right and a corresponding left rudder movement. The autopilot, when engaged could be expected to counter this with opposite movement on the trim tab, and the lack of security and stiffness in the rudder location might well have produced vibration. The HS 748 aircraft requires increasing right rudder trim with increasing speed. If, therefore, the autopilot was engaged at a low airspeed, say in the climb, there would exist a significant out of trim condition when the autopilot was disengaged at 225 knots in the descent. Given the condition of the bottom rudder hinge, such an out of trim condition could well have the effect that initiated the severe roll/yaw oscillation described by the flight crew.

In view of the fact that there is considerable evidence that the damage to the rudder hinge was caused by strong lateral wind gusts, the Meteorological Office, Bracknell, were requested to provide details of the maximum recorded gusts at various highland and island aerodromes into which the company operated. The figures show that, between 26 January 1986 and 10 March 1986, the subject aircraft was parked over-night on 11 occasions in wind speeds between 25 and 30 knots, on 6 occasions in speeds between 31 and 35 knots, and on 4 occasions at speeds between 36 and 40 knots. In addition, during the same period there were 6 occasions when, during daylight operation, gusts in excess of 55 knots were recorded.

Following the incident on 10 March 1986, and other reported incidents of wind slam damage to rudder hinge bearings, the aircraft manufacturer issued a Notice to Operators giving guidance to HS 748 pilots on procedures recommended to reduce risk of such incidents occurring in high surface wind conditions.