DHC-8-311A Dash Eight, G-BRYM, 18 September 1996

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Aircraft Type and Registration:	DHC-8-311A Dash Eight, G-BRYM
No & Type of Engines:	2 Pratt & Whitney Canada PW-123 turboprop engines
Year of Manufacture:	1991
Date & Time (UTC):	18 September 1996 at 0926 hrs
Location:	Plymouth City Airport
Type of Flight:	Public Transport
Persons on Board:	Crew - 4 - Passengers - 49
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Minor fuselage skin damage
	Frangible 'Touched Runway' sensor destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	15,191 hours (of which 727 were on type)
	Last 90 days - 152 hours
	Last 28 days - 30 hours
Information Source:	AAIB Field Investigation

History of flight

The crew reported at 0505 hrs to operate six sectors, being twiceround the route Plymouth-Newquay-Heathrow-Plymouth. Towards theend of the third sector, inbound to Plymouth at 0922 hrs, thecrew contacted Plymouth Approach Control while 13 miles east ofthe airport. The 0850 hrs METAR observation for Plymouth had beenpassed to the crew previously by London Military Radar Controlas 100°/26 kt gusting 39 kt, visibility 17 km, cloud fewat 2,500 feet. The temperature was 13°C and the QNH 1009/QFE992 mb. The aircraft was cleared to self position onto a leftbase leg for a visual approach to Runway 13. The First Officerwas the handling pilot for this sector. The

landing crosswindcomponent was within the company limits for him to complete thelanding as handling pilot (aircraft crosswind limit 30 kt, FirstOfficer handling crosswind limit 20 kt). The First Officer hadbeen flying the type for some two years and had a total flyingexperience of 2,834 hours, of which 893 were on type. His 28 and90 day flying totals were 85 and 178 hours respectively.

The maximum permitted landing weight was 41,885 lb and the actuallanding weight was 40,644 lb. The crew elected to make anapproach with full flap (35°), using a VREFof 100 kt, which was appropriate to a landing weight of 41,000lb. The approach speed to be used was as recommended by the manufacturerat VREF, to which was added half of the gustvalue (with an overall maximum increment of +10 kt), giving atarget approach speed of 107 kt. Plymouth Runway 13 has a LandingDistance Available of 1,038 metres. For a 35° flap landing,the LDA from the company Operations Manual was 1,007 metres (stillair), or 897 metres when factored for the steady headwind component.

The flight crew commented that flying conditions were smooth untilthe aircraft descended below 1,000 feet when constant moderateturbulence and indicated airspeed fluctuations was experienced.This turbulence had been anticipated as the crew were based atPlymouth and were familiar with the local effects of strong winds.They decided to configure the aircraft early on the approach,so 35° flap was selected at about 800 feet agl and the aircraftsettled at an approach speed of around 110 kt, but fluctuatingwith the turbulence being experienced. The landing checks werecompleted, landing clearance was obtained from ATC and a finalwind check was passed as 100° at 20 kt gusting 30 kt. TheFirst Officer requested confirmation that the airspeed was acceptableon short final and the commander replied that it was good. Theaircraft flared normally with the left wing slightly down to compensatefor the crosswind component and the power was progressively reducedto flight idle. The crew considered that the aircraft toucheddown earlier than anticipated, on the left main wheel first followedquickly by the right main wheel. A slight bounce then followedbefore a further firm touchdown. A normal rollout ensued. Thepitch attitude at the flare and bounce did not seem excessiveto the crew.

Ground contact with the rear fuselage went unnoticed by the aircraftoccupants, but the flight deck crew noted that the Red 'TouchedRunway' warning caption on the CAUTION/WARNING LIGHTS PANEL wasilluminated during the taxy in. The aircraft was parked and shutdown normally before being withdrawn from service for repair.

The commander considered that the approach had been normal giventhe nature of the turbulence and windshear experienced. He consideredthat an application of power at the flare to compensate for thesudden loss of airspeed may have prevented the firm touchdownand rear fuselage strike.

The previous landing aircraft was a Piper PA-28 which landed onRunway 13 at 0924 hrs. Its pilot indicated that he experienceda loss of airspeed of about 20 kt on short finals. He did notcomment by R/T to ATC on this experience.

Airport information

The UK AIP entry for Plymouth contains the warning note: *'Instrong wind conditions, windshear and turbulence may be experiencedon the approach to or climb out from any runway. Downdraught effectand sudden changes in wind velocity are possible in light windconditions.'*

Plymouth Airport is equipped with a Vaisala WAD21M Anemometersystem with two wind sensors, one by the threshold of the maininstrument Runway 31, the other close to the intersection

of thetwo runways. On the day of this accident the latter sensor wasunserviceable so all references to surface wind for R/T transmissionsand METAR observations were taken using the Runway 31 thresholdanemometer. The crew were neither advised of this situation byATC, nor was there any requirement to pass such information. Thestandard practice is for ATC to pass the 2 minute average windby R/T for aircraft movements, but to supply the 10 minute averagevalue for METAR purposes. METAR observations are compiled by ATCpersonnel holding Met Observer Certificates and are currentlytaken at hourly intervals.

Engineering Inspection

The frangible switch for the 'TOUCHED RUNWAY' flight deck captionhad been destroyed in the contact between the aft fuselage andthe runway. The two fuselage frames adjacent to the frangibleswitch (stations 626.5 and 642.5) had both suffered skin damageand the geometry of these marks showed that, at contact with therunway, the aircraft had been close to wings level and almoststraight (nose 3° to the right). The corresponding mark onthe runway started some 131 metres from the runway threshold,close to the runway centre line, and extended for 4.8 metres.The airframe damage was similar, but slightly less severe, tothat caused to another DHC-8-311 in Jersey in May 1995 (reportedin AAIB Bulletin 7/95).

From the aircraft geometry it is apparent that the fuselage attitudeat which the rear fuselage of a DHC8300 will contactthe runway is approximately 8.5° - 9°, with the mainlanding gear oleos fully compressed.

Flight Recorders

The aircraft was fitted with a Loral F800 Flight Data Recorder(FDR) and a Sundstrand Cockpit Voice Recorder (CVR). Both recorderswere removed from the aircraft and replayed using standard techniques.The FDR contained a recording of aircraft data from the last 25hours of aircraft operation whilst the CVR contained the last30 minutes of the accident flight.

The data from the FDR showed that the flight had been uneventfuluntil the landing. During the final approach, at a radio altitudeof 14 feet, there was an increase in indicated airspeed from 100 ktto 107 kt, coincident with the start of a reduction in angleof attack. One second later, at a radio altitude of 5 feet, theindicated airspeed dropped sharply to 89.5 kt and the angle ofattack decreased further to -3.7°. Between 12.5° and14° of nose-up elevator was applied at that time and theaircraft began to pitch up. Over the subsequent second the angleof attack increased rapidly to +12.8° and the indicated airspeedincreased to 99 kt. While the pitch attitude of the aircraft wasstill increasing, 7.5° of nosedown elevator was applied.Engine torques had decreased steadily during whole of this periodfrom 20% to 5%.

The aircraft's rear fuselage struck the ground at this time andthe resultant acceleration pulse caused the FDR to corrupt thedata recording for a period of 0.25 seconds. The uncorrupted dataimmediately after the rear fuselage strike showed that the pitchattitude of the aircraft was 7.3° nose-up, angle of attackwas +11.1° and vertical acceleration was 1.75 g.

Following the rear fuselage strike, the aircraft bounced to aheight of 5 feet for a period of just over 2 seconds beforelanding and rolling out. This second landing occurred at 91 ktwith a pitch attitude of 4° noseup and, although ithad resulted in a vertical acceleration of 2 g, data corruptionwithin the FDR did not occur.

Although ground speed was not recorded on this aircraft it wasderived using a stabilised airspeed and wind information for aninitial point and subsequently longitudinal acceleration and aircraftpitch attitude. During the period immediately prior to the rearfuselage strike, although indicated airspeed showed a momentarydecrease of 17.5 kt, no such variation was seen in the derivedground speed, indicating that the wind speed had decreased andnot the speed of the aircraft.

Aircraft information

The Aircraft Flight Manual contains the following Caution note:*'Pitch attitudes greater than 6° in the landing flaremay cause the fuselage to contact the runway.'*

Apart from this incident and the previous occurrence in the UKreferred to above, three other landing rear fuselage strike eventshave been experienced on the -300 series. In each case, the 'TouchedRunway' sensor has correctly alerted the crew to the situation.

The manufacturer was supplied with the FDR data from this occurrenceand concluded that the aircraft was being flown at the properapproach speed. Given the sudden loss of airspeed at the flare,the only crew action that could have prevented the rear fuselagestrike was an immediate advancement of the power levers in orderto reduce the aircraft's sink rate without having to exceed therecommended pitch attitude of 6° for a normal landing.

Subsequent actions

Following this occurrence, the operator has introduced the followingrevised standard operating procedures:

"First Officers may carry out landings at Plymouth subjectto the discretion of the Captain and the following limitations;

1. Maximum windspeed of 15 kt including gusts

2. Maximum tailwind of 5 kt

3. Minimum cloudbase of 500 feet and visibility of 2,000 metres

Furthermore, First Officers, who are not Plymouth based, are notpermitted to carry out landings at Plymouth until they have completed3 months line flying."