

No: 3/90

Ref: EW/C1143

Category: 1a

**Aircraft Type
and Registration:**

Shorts SD 3-60-100, G-OLTN

No & Type of Engines:

2 Pratt & Whitney PT6A-65R turboprop engines

Year of Manufacture:

1988

Date and Time (UTC):

20 December 1989 at 1755 hrs

Location:

Bristol Airport

Type of Flight:

Public Transport

Persons on Board:

Crew - 3 Passengers - 19

Injuries:

Crew - None Passengers - None

Nature of Damage:

Nose landing gear collapsed - broken nose landing gear door rods, minor skin wrinkling and abrasive damage to underside of nose section

Commander's Licence:

Airline Transport Pilot's Licence

Commander's Age:

62 years

**Commander's Total
Flying Experience:**

12,000 hours (of which 800 were on type)

Information Source:

AAIB Field Investigation

The aircraft was on a scheduled public transport passenger flight from Leeds/Bradford to Bristol Airport. After a normal transit, on landing at Bristol the aircraft's nose landing gear collapsed. The aircraft came to rest on the north edge of runway 27 where the engines were shut down, the crew and passengers vacated the aircraft and were transferred to the terminal by coach. There were no injuries.

History of the Flight

The aircraft schedule had started from Glasgow and it landed at Leeds/Bradford at 1630 hrs, approximately 50 minutes late, where a fresh crew took over. This flight crew, comprising two pilots and one stewardess, reported for duty at Leeds/Bradford Airport at 1510 hrs. Prior to this time both the pilots had completed rest periods of 27 hours and 55 minutes. There were no entries of any unserviceabilities in the aircraft's technical log, however some throttle stagger in the cruise was reported during a verbal handover. Fuel was on-loaded to a total of 1710 kg, and the take off weight was 11256 kg, with an estimated landing weight of 10806 kg. The maximum permitted take off and landing weights are 12292 kg and 12020 kg respectively. The aircraft's centre of gravity was within the permitted limits throughout the flight.

Before departure the flight crew collected a weather forecast for the route, including Terminal Aerodrome Forecasts (TAFs) for the destination and alternate airports. (A detailed description of the

meteorological conditions relating to the flight is included at the end of this Bulletin.) The aircraft took off from Leeds/Bradford at 1650 hrs, having been cleared by ATC for an IFR flight, routeing Pole Hill VOR, W923 to Stafford then direct to Bristol at a cruising level of FL90.

Cruising flight through the Manchester Zone was reported to be normal in generally smooth conditions with good visual contact with the ground 70% of the time. The London South VOLMET was tuned, and the 1650 hrs Bristol Airport weather as surface wind 230/18, visibility 10 km or more, showers, cloud 5 at 1200 and 7 at 3000, with a temperature of plus 11 was noted. ATC control was transferred to Brize Radar at 1722 hrs, and a descent was commenced at 1734 hrs and control transferred to Bristol. During the descent the Cardiff Automatic Terminal Information (ATIS) radio frequency was listened to and the details noted. The Bristol radar controller advised the latest weather report as surface wind 200/15, visibility 16 km, cloud 6 oktas cumulo-nimbus 4000, 7 at 6000, temperature plus 11, QNH 989, runway wet, and, shortly afterwards, at 1747 hrs informed the aircraft that his radar showed heavy thunderstorm activity to the east of the airport, and offered radar vectors to 5 miles finals on the runway 27 ILS. The aircraft commander, who was the handling pilot, accepted this offer and briefed for an ILS approach to that runway. Full ILS minimums of 200 feet was noted and set, and both pilots 'bugged' a target threshold speed (Vref) of 98 knots. However due to the moderate and occasionally severe turbulence that was being experienced, the commander states that it was his intention to aim for Vref + 10 knots at the runway threshold.

At 1751 hrs the crew reported that the aircraft was established on the ILS localiser, and landing clearance was given with a surface wind of 230/18 knots and the runway wet with water patches. The commander reports that he flew a manual approach from 1400 feet and that as he commenced the flare, a wind gust was experienced but it did not appear to be severe. On touch down the aircraft bounced and on the second touch down there was a loud bang from the nose landing gear area and the landing gear 'unsafe' warning horn sounded continuously. After it was brought to a stop on the northern edge of the runway, it was found that it was not possible to taxi the aircraft and the engines were shut down in situ. The Bristol ATC aerodrome controller declared a full emergency and four appliances were despatched to the scene. There were no injuries and all occupants were transferred to the passenger terminal by coach.

Engineering aspects

Examination of the runway revealed scrape marks commencing approximately 40% of the total runway distance along from the 27 threshold. From here it could be seen that the aircraft had drifted slightly to the left of the centre line before turning to the right towards a taxiway, eventually coming to a halt some 350m from the initial runway contact.

Prior to moving the aircraft off the runway, the airport fire service raised the nose and rested it on a baggage trolley. This allowed the nose landing gear to drop down from the wheel well and into downlocks. The aircraft was then towed (with the nose still supported on the trolley) to an adjacent taxiway for examination.

The nose landing gear on this aircraft is of the levered suspension type, with a beam assembly pivoted at the bottom of the oleo piston. The wheel is carried in forks at the rear end of the beam, the forward end being attached to the upper torque link. Thus the nosewheel forces are reacted by bending loads in the forward part of the beam. It was apparent that the latter had failed across the hole through which had passed the pin attaching it to the upper torque link. The failure had then progressed in a peeling action causing a section of the beam to be released, this was subsequently retrieved from the runway. There was therefore nothing to prevent the forward end of the beam from contacting the runway and being progressively ground away during the groundslide.

It was also apparent that the nose landing gear had come out of downlocks, allowing the leg to retract rearwards into the well. The downlock assembly consists of a spring-loaded plunger contained within a housing at the front of the leg. During landing gear extension the plunger rides up the chisel-nosed edge of the downlock plate at the forward edge of the wheel well before slotting into a hole within the plate. The plunger is hydraulically withdrawn for landing gear retraction. When the plunger moves into the downlock position, it contacts a lever which operates the downlock microswitch. If the plunger fails to locate, a "gear unsafe" warning results, accompanied by a warning horn when the throttles are retarded. It was thought probable that the downlock plunger came out of engagement due to elastic structural deformation during this impact, which allowed the downlock to engage normally when the leg was lowered following the accident. Once out of downlocks, the leg folded rearwards, the ram of the extension/retraction actuator failed in a compressive buckling mode as it attempted to resist this motion.

Other damage included broken nose landing gear door operating rods, together with minor skin wrinkling and abrasion damage to the underside of the nose and to the doors.

A metallurgical examination of the nosewheel beam fracture surface revealed that there had been an overload failure due to excessive bearing stress experienced during the heavy landing.

Flight Recorders

The CVR was a Fairchild A100A 4-Channel 'Hot Mike' recorder. The recorded channels were the P1 and P2 positions, the public address system, and an area microphone on the flight deck. The quality of the play back was good at all positions. The area microphone channel recording confirms that the landing gear 'unsafe' warning horn sounded immediately after the second touch down, and remained on until power was shut down.

The FDR was a Plessey 1584G-DFDR which recorded 17 analogue parameters and 8 discrete events. The quality of data retrieved was good except that there was some loss of data immediately after touch down. A summary of data relevant to the final stages of the approach and the landing is included in graphical form at the end of this report. Analysis of this data resulted in the following conclusions:

- (a) Engine power. The difference between the torque recorded during the approach confirms the throttle stagger reported by the flight crew.

(b) Airspeed. The rapid fluctuations in the airspeed trace indicate gusty conditions and turbulence. Touchdown airspeed is calculated to have been 114 knots, however this is subject to a possible error of + or - 5 knots.

(c) Elevator demands. The elevator position channel shows increasing nose down demands shortly before touch down. (N.B. Nose down demands shown as positive on the graph.)

(d) Pitch. The nose down pitch on the approach is maintained until touch down which is at 4 degrees nose down.

(e) Vertical acceleration. The vertical acceleration or 'g' line indicates moderate turbulence throughout the approach. It also shows two 'spikes' where the first and second touch-downs occurred. The first shows a peak of 2.2g followed, 1.5 seconds later, by a peak of 1.8g. Both these peaks are co-incident with a pitch attitude of 4 degrees nose down.

Meteorological information

The Terminal Aerodrome Forecasts (TAFS) for Bristol and Cardiff Airports for the period 1300 hrs to 2200 hrs on 20 December 1989 were as follows:

BRISTOL 24020/32KT 9999 2CU015 5SC040 TEMPO 3000 81XXSH/95TS 7CB005

CARDIFF 23018/30KT 9999 4CU018 5SC040 TEMPO 4000 81XXSH/95TS 7CB008

An aftercast of the actual conditions prevailing has been provided by the Meteorological Office, Bracknell and is as follows:

Synoptic Situation: A strong unstable southwesterly airstream covered the area.

Weather: Occasional rain, heavy at times with local thunder

Visibility: 10KM or over in rain and 5KM or less in heavy rain or thunderstorms

Cloud: SCT ST base 400ft BKN CB base 800 ft merging with BKN SC AC layers base 6000ft tops 30000ft

Winds/Temps:	Surface	210	15KT	PS11
	1000ft	230	30KT	PS12
	2000ft	230	60KT	PS09
	5000ft	230	50KT	PS04

Remarks: No gusts were reported at Lulsgate, Filton or Bristol Weather Centre but because of thunderstorm activity in the area gusts to near the gradient speed could have been brought down to near the surface locally. With the rapid increase of wind in the lower layers severe low level turbulence would be expected.

Windshear Alerting Services are available at certain Airports in the United Kingdom. Forecasters for London/Heathrow and Belfast/Aldergrove airports review the weather conditions at those airports on an hourly basis and monitor reports of windshear experienced on approach or climb out. Where a potential low level windshear condition exists an Alert is issued, based on one or more of the following criteria:

- (a) Mean surface wind speed at least 20kt.
- (b) The magnitude of vector difference between the mean surface wind and the gradient wind (2000ft) at least 40kt.
- (c) Thunderstorm(s) or heavy shower(s) within approximately 5nm of the Airport.

Surface wind conditions transmitted to pilots landing at Bristol are derived from a Wind-Anemometer MkIV, with the anemometer head sited 80 feet above the airport datum level. The unsuitability of this siting has been the subject of comment in reports by the Cardiff Weather Centre following annual inspections on 17 October 1988 and 25 October 1989.

Bristol Airport does not have a Windshear Alert Service. If it had had one, a warning of wind shear would probably have been issued prior to the time of this accident.

