

Aircraft type and registration: Embraer 110 Bandeirante G-HGGS (light twin-engined fixed wing aircraft)

Year of Manufacture: 1980

Date and time (GMT): 19 November 1984 at 2059 hrs

Location: Near Saddle Hill, Inverness, Scotland

Type of flight: Public Transport

Persons on board: Crew — 1 Passengers — None

Injuries: Crew — 1 (fatal) Passengers — None

Nature of damage: Aircraft disintegrated on impact

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 30 years

Commander's total flying experience: 2800 hours (of which 95 were on type)

Information Source: AIB Field Investigation

History of the flight

The aircraft was scheduled to undertake a series of night mail flights consisting of five sectors. It had departed from Aberdeen at 2000 hrs and arrived at Inverness (Dalcross) at 2025 hrs. Following this first sector, no defects had been reported or recorded.

The commander assisted with the loading of 2346 lb of mail, such that the aircraft was 390 lb below its maximum permitted take-off weight and 160 lb below the regulated take-off weight. The planned flight time on the next sector, to Edinburgh, was 40 minutes and the aircraft had 1600 lb fuel remaining on board, sufficient for some 3 hours' flying.

The meteorological conditions reported at Inverness at the time of the accident were:—

Wind: 020°/5 kt
 Visibility: 16 kilometres
 Cloud: 2 oktas 500 feet, 5 oktas 1100 feet, 6 oktas 1400 feet
 Temperature: Plus 6°C
 QNH: 1004
 Precipitation: Nil

No significant turbulence, or risk of icing when clear of cloud, was forecast or considered likely in the area at the time of the accident.

The flight was cleared by Air Traffic Control to fly direct to Edinburgh at Flight Level 95 and, after take-off from runway 24, to make a left turn onto track. The normal method of achieving this track is to intercept and follow the 175° radial from the VHF omni-range (VOR) beacon situated on the airfield, and the minimum safe altitude promulgated for flight in this area is 4,800 feet. The aerodrome elevation is 31 feet above mean sea level (amsl).

G-HGGS took off at 2055 hrs and the Air Traffic Controller states that the take-off appeared to be normal. However, three witnesses standing outside the terminal buildings state that the aircraft appeared to maintain an unusually level flight path, at about 100 feet, until they lost sight of it behind the buildings. Whichever of these take-off profiles was followed, the aircraft climbed ahead to a position short of Inverness town, and returned on an approximately reciprocal track to intercept and take up the 175° radial from the VOR beacon on the airfield.

Approximately 4 minutes after take-off, the aircraft was seen flying, apparently level, in a southerly direction at a height which was unspecified but low enough to be below the main cloud base. Less than a minute later a 'dying orange glow' was seen in the area of the accident site.

A search was commenced shortly afterwards but due to uncertainty about the aircraft's position it was not until early on the morning of 21 November, when the weather cleared, that the wreckage of the aircraft was found. The aircraft had flown into the side of a hill at 1600 feet amsl and disintegrated on impact. There were only small areas of locally contained fire.

Personnel information

Aircraft Commander: Male
Age: 30 years
Licence: Airline Transport Pilot's Licence issued January 1983 valid until 9 January 1993
Ratings: PA23, 34 and 44 (except supercharged engined versions)
BN 2A and 2B Islander (except supercharged engined versions)
EMB 110 Bandeirante
Instrument rating: Valid until 31 January 1985
Certificate of test: 4 October 1984
Medical Certificate: Issued 13 August 1984 and valid (as a Commercial Pilot) until 31 August 1985

Post mortem examination disclosed no evidence that any medical factor contributed to the accident. Witnesses state that the commander did not appear depressed or tired prior to take-off.

The commander left the Royal Air Force with nearly 1200 flying hours' experience and, having gained his Airline Transport Pilot's Licence, joined the airline in January 1983. He flew Piper Aztecs and a Britten-Norman Islander until 2 October 1984, and completed the company conversion to the Bandeirante on 4 October 1984. The accident flight was the commander's 14th flight into and out of Inverness, the previous one having been on 5 November 1984; he had not been on duty since 0750 hrs on 17 November.

Throughout the commander's training with the company on all three types of aircraft, he is reported as having very high ability and standards. Nevertheless, during two sectors of a flight carried out three days before the accident, the commander was seen by a company pilot (passenger) to select a propeller speed (Nh) setting of 83% rpm, rather than the more usual 91%, for the climb out procedures from Aberdeen and Edinburgh.

Examination of the wreckage

The accident site lay on the side of a hill some 6½ miles south of Dalcross airport. First contact with the ground had been made by the port propeller, which left three slash marks in the heather, and the starboard propeller, which left two similar marks. Thereafter, a longitudinal cut made by under-fuselage aerials led into a shallow main impact crater. It was evident that the impact angle had been relatively shallow, that both propellers had been rotating at similar rpm, and that the aircraft was banked slightly to the right, since the ground sloped to the right at the point of impact.

The initial impact had been sufficient to completely disrupt the fuselage and wing centre section structure into large segments which were thrown forwards over a distance of some 180 metres. A severe fire had developed in the inboard wing sections but, due to the spread of the wreckage, most of the debris was unaffected by fire. The aircraft's track on impact had been 175° Magnetic.

Measurement of the propeller slash marks suggested that, by assuming propeller rpm in the range 83%—100%, the aircraft's ground speed had been between 174—210 kt.

Following removal of the wreckage to the AIB Hangar at Farnborough, it was possible to determine that the majority of the under-fuselage and centre wing structure had taken the brunt of the ground impact. The lack of fore-shortening of the fuselage pointed towards the aircraft being in a moderately nose-up attitude at impact. No evidence of pre-impact, fire, explosion, structural failure or malfunction of the flying control systems was found. It was possible to determine that the flaps were up, and that the undercarriage was retracted and locked.

Examination of the cockpit instrument bulb filaments showed that a large number of them exhibited 'hot stretching', indicating that they were illuminated at impact. A similar examination of the filaments in the Autopilot Control panel push-buttons clearly showed that the Autopilot had been engaged (implying a pitch attitude hold function) and that the 'heading' mode was also selected.

Two of the three gyro instruments displaying heading and track information to the pilot still reflected the impact heading of 175° Magnetic, and both the heading 'bug' and Omni Bearing Selector (OBS) on the Horizontal Situation Indicator showed that 175° had been selected.

It was not possible to determine the altimeter readings at impact, although both instruments had 1004 millibars (the correct pressure setting) set on their subscales.

Flight trial

Following the accident, the AIB carried out a trial flight in a similar Bandeirante loaded to approximately the same conditions as G-HGGS. Previous examination of the evidence showed that, excepting arbitrary turns carried out to no obvious purpose, G-HGGS must have maintained runway heading for about 2 miles, and then turned back on to an approximately reciprocal heading so as to intercept the 175° radial from the VOR beacon on the airfield. This flight profile was therefore copied. The company's normal climb procedures provide for a setting of 91% propeller rpm and a speed of 140 kt. Nevertheless, the commander of G-HGGS had been known to use 83% propeller rpm and the evidence provided by the wreckage suggested a speed of approximately 180 kt at impact. Combinations of these parameters were therefore used during the trial flights, the results of which are shown below:

Test	Climb Speed	Propeller rpm	Height/time over Accident Site	Flight time to achieve 1600 feet (amsl)
1	140 kt	91%	5000 feet/5 minutes	90 seconds
2	140 kt	83%	4000 feet/4½ minutes	2 minutes 40 seconds
3	180 kt	91%	2200 feet/4½ minutes	2 minutes 50 seconds
4	180 kt	83%	1600 feet/4½ minutes	4½ minutes

(All the above readings were taken at an engine torque setting of 1400 ft-lbs.)

The distance for which runway heading was maintained varied between 2 and 2½ miles according to whether 140 or 180 kt speeds were used.

It was noted that, despite the remarkable coincidence of height and time in Test 4 with those of the accident flight, the rate of climb displayed by the vertical speed indicator in this test was so small that it demanded the attention of the pilot.

Conclusion

Although various hypotheses could be formulated to fit these flight profiles, there is no evidence which would enable a determination as to the cause of the accident to be made with any degree of certainty.