

No: 10/90

Ref: EW/C1167

Category: 1a

**Aircraft Type
and Registration:**

BAe 146-200 series, G-PRIN

No & Type of Engines:

4 Lycoming ALF 502-R5 turbofan engines

Year of Manufacture:

1988

Date and Time (UTC):

16 June 1990 at 1332 hrs

Location:

Jersey Airport, Channel Islands

Type of Flight:

Public Transport

Persons on Board:

Crew - 4 Passengers - 93

Injuries:

Crew - None Passengers - None

Nature of Damage:

Damage to underside of rear fuselage with minor perforation of the pressure hull

Commander's Licence:

Airline Transport Pilot's Licence

Commander's Age:

36 years

**Commander's Total
Flying Experience:**

8,223 hours (of which 63 were on type)

Information Source:

AAIB Field Investigation

History of Flight

The aircraft was scheduled for a 1205 hrs departure from Southend to Jersey. The calculated take-off weight was 35,033 kg which, using the standard data card for 35,000 kg, gave the following take-off speeds and bug settings:

White outer bug	V1	101 kt
Yellow outer bug	VR	105 kt
Orange inner bug	V2	111 kt (Command bug)
Orange outer bug	V2+10	121 kt
Red outer bug	VFTO	169 kt

The aircraft took-off at 1249 hrs with the commander acting as handling pilot. Shortly before the top of descent he made several unsuccessful attempts to contact the Jersey handling agent on 130.6 MHz. The difficulty was experienced because of the high volume of traffic on the frequency, which is common to handling agents at several airfields.

Descent started over Cherbourg and the Descent Check was initiated. A call from the handling agent interrupted the checklist at the LANDING DATA item. The commander having indicated to the first officer that he would come back to the check, answered the call.

The calculated landing weight was 33,472 kg which, using the standard data card for 33,500 kg, gave the following landing speeds and bug settings;

White outer bug	VREF33	113 kt
Orange inner bug	VREF+5kt	118 kt (Command bug)
Yellow outer bug	VREF+20kt	133 kt
Orange outer bug	VFTO	170 kt
Red outer bug	VFTO+15kt	185 kt

Once the call to the handling agent was complete the commander's concentration was focussed on instructions from ATC and the further conduct of the flight. He stated that he thought that he may have repositioned the yellow outer bug but could not recall moving the others from their take-off settings. The first officer recalled that, at some stage, he looked across at the commander's ASI and thought that the bugs looked to be correctly set. The setting of the commander's orange inner command bug is not visible from the normal righthand seating position.

The aircraft was cleared for a visual approach to runway 09. The commander reported that, at about 800 ft amsl, the aircraft was established on the final visual approach path with 33° flap, 56% N1 and at a reducing airspeed of "VREF+15kt". At about 500 ft amsl the first officer noticed that the airspeed which should have been 118 kt, had reduced to 1 or 2 kt below his VREF33 bug which was set at 113 kt. He called "Speed" to which the commander replied "On bug", meaning his orange inner command bug which was set at 111 kt. At about 400 ft amsl the airbrakes were selected out and the aircraft encountered a slight sink as it passed over the cliff on short final. The airspeed was allowed to reduce in order to cross the threshold at about 106 kt, the value the commander had set on his VREF33 bug.

The commander assessed that the aircraft was slightly low as it crossed the threshold, but considered that the landing flare would lead to a touchdown about 200 metres in from the runway end. The throttles were closed and the flare was initiated, however, there was no noticeable decrease in the rate of descent and the aircraft struck the ground, firmly, in a high nose-up attitude. The aircraft was taxied to the ramp and the passengers were disembarked in the normal manner. An external inspection subsequently revealed that the lower aft fuselage was damaged.

Aircraft Examination & Ground Marks

When the aircraft was examined by the AAIB, later the same day, the lefthand ASI orange inner command bug was found to be set to 111 kt and the righthand to 118 kt. The remaining bugs had been 'stacked', as required by company standard operating procedures.

The tail bumper had contacted the ground hard, compressing the aluminium honeycombe shock absorber by several inches, and the aft water drain mast had been scraped. The lower fuselage in the region between the freight door and the drain mast was damaged by contact with the paved runway surface, producing a region of localised skin damage and frame buckling over an area approximately 2.3 metres by 0.3 metres, with abrasion and penetration of the skins in several areas local to the frames. The frames over this same region also displayed signs of slight generalised distortion extending up to the level of the cabin floor.

Scrape marks produced by the lower fuselage and tail bumper, together with the mainwheel touchdown marks, were identified in the paved undershoot beginning approximately 24 metres before the threshold 'piano key' markers. The marks were consistent with a moderately heavy touchdown in a very nose high attitude, wings level, and with about 2 degrees of right yaw.

Flight Recorders

The Flight Data Recorder fitted was a Plessey PV1584 J1 recorder which has 32 analogue parameters and 29 discrete events. This was removed and returned to AAIB for replay where a satisfactory readout was obtained except around touchdown where approximately one and a half seconds of data was lost, probably due to the impact. The Cockpit Voice Recorder was not removed as following the accident power had been applied to the aircraft so the relevant period during the approach and landing would have been erased.

The FDR calibration figures taken in November 1989 for this particular aircraft were obtained from the manufacturer and were used to obtain engineering units from the raw data. To confirm the IAS calibration a check was made by AAIB on the aircraft pitot/static system, for both the captains and co-pilot's instruments (connected to P1/S1 and P2/S2 systems respectively) and the flight recorder system which takes IAS values from a transducer connected to the P3/S3 system.

The results of these tests showed that the captains ASI over-read by approximately 2-3 kt when the IAS was between 80 and 120 kt. The co-pilots ASI over-read by about 1 kt in the same speed range. The manufacturers maintenance manual allows for a tolerance of 4 kt on the ASI reading from the reference value (*ie* ± 2 kt).

Testing of the flight recorder system showed that the calibration had changed since November 1989. The maintenance manual quotes an acceptable range for the FDR reading against the reference IAS value, the latest calibration showed the readings were no longer within limits at IAS values between 80 and 100 kt. The new calibration was used to obtain the FDR IAS values quoted below.

There are no position error differences between the standard system supplying the cockpit instruments (P1/S1 and P2/S2) and the P3/S3 systems used for the FDR.

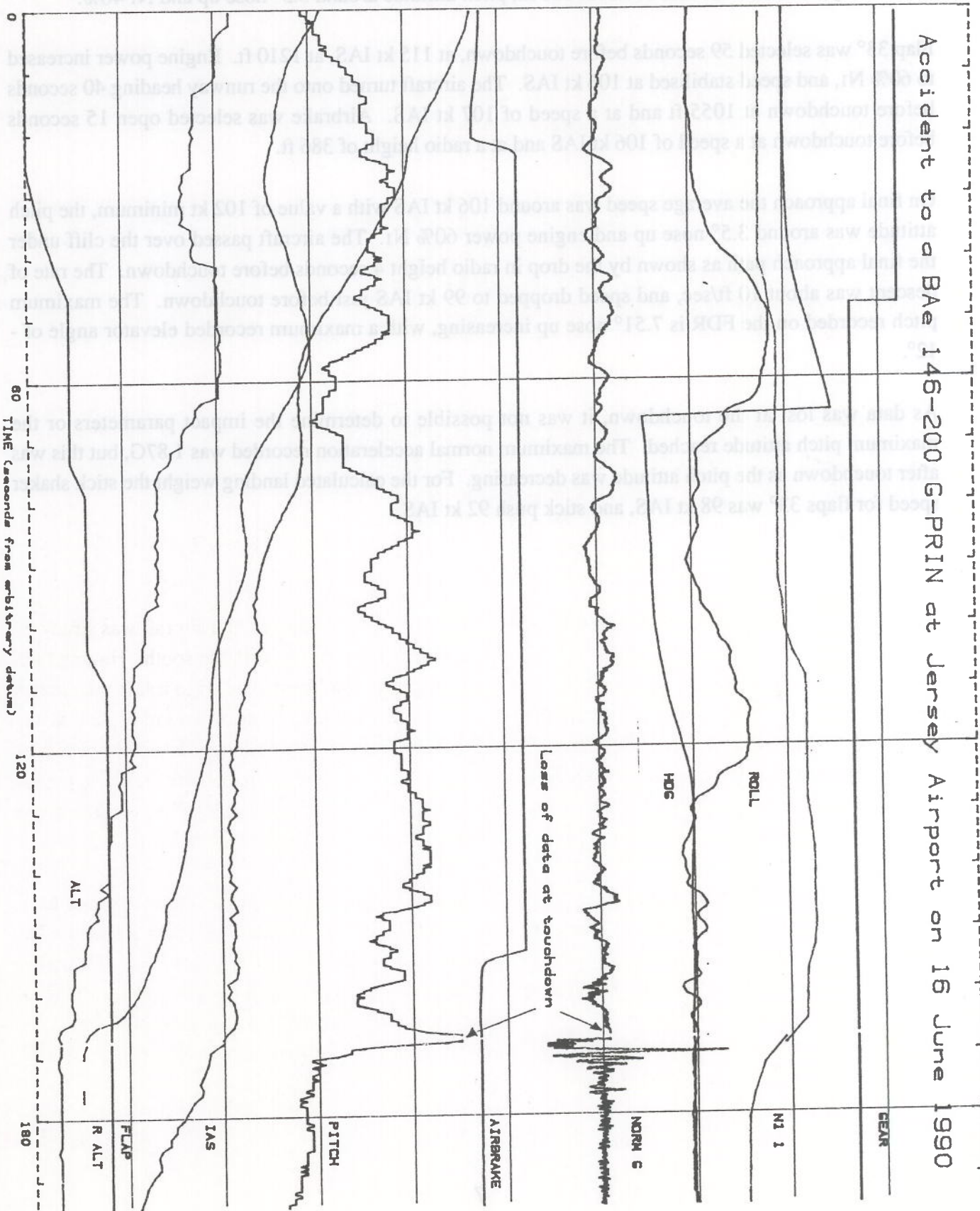
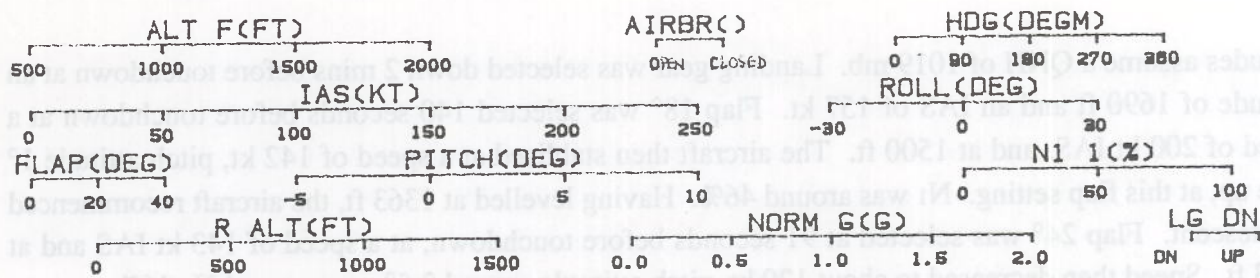
The attached figure shows the approach, with a selection of the relevant FDR parameters plotted. It should be noted that the ALT trace is referenced to the standard pressure of 1013 mb. The following

altitudes assume a QNH of 1019 mb. Landing gear was selected down 2 mins before touchdown at an altitude of 1690 ft and an IAS of 157 kt. Flap 18° was selected 140 seconds before touchdown at a speed of 200 kt IAS, and at 1500 ft. The aircraft then stabilised at a speed of 142 kt, pitch attitude 1° nose up, at this flap setting. N1 was around 46%. Having levelled at 1363 ft, the aircraft recommenced the descent. Flap 24° was selected at 91 seconds before touchdown, at a speed of 143 kt IAS and at 1183 ft. Speed then decreased to about 120 kt, pitch attitude around 3.5° nose up and N1 46%.

Flap 33° was selected 59 seconds before touchdown, at 115 kt IAS, at 1210 ft. Engine power increased to 60% N1, and speed stabilised at 106 kt IAS. The aircraft turned onto the runway heading 40 seconds before touchdown at 1055 ft and at a speed of 107 kt IAS. Airbrake was selected open 15 seconds before touchdown at a speed of 106 kt IAS and at a radio height of 386 ft.

On final approach the average speed was around 106 kt IAS with a value of 102 kt minimum, the pitch attitude was around 3.5° nose up and engine power 60% N1. The aircraft passed over the cliff under the final approach path as shown by the drop in radio height 4 seconds before touchdown. The rate of descent was about 10 ft/sec, and speed dropped to 99 kt IAS just before touchdown. The maximum pitch recorded on the FDR is 7.51° nose up increasing, with a maximum recorded elevator angle of -12°.

As data was lost at the touchdown, it was not possible to determine the impact parameters or the maximum pitch attitude reached. The maximum normal acceleration recorded was 1.87G, but this was after touchdown as the pitch attitude was decreasing. For the calculated landing weight the stick shaker speed for flaps 33° was 98 kt IAS, and stick push 92 kt IAS.



Accident to a Bae 146-200 G-PRIN at Jersey Airport on 16 June 1990