
Tailstrike on landing, BAe 146-200, G-MANS

Micro-summary: This BAe-146-200 experienced a tailstrike on landing.

Event Date: 2003-03-30 at 1757 UTC

Investigative Body: Aircraft Accident Investigation Board (AAIB), United Kingdom

Investigative Body's Web Site: <http://www.aaib.dft.gov/uk/>

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BAe 146-200, G-MANS

AAIB Bulletin No: 3/2004	Ref: EW/C2003/03/03	Category: 1.1
INCIDENT		
Aircraft Type and Registration:	BAe 146-200, G-MANS	
No & Type of Engines:	4 Lycoming ALF 502R-2 turbofan engines	
Year of Manufacture:	1987	
Date & Time (UTC):	30 March 2003 at 1757 hrs	
Location:	Brussels Airport, Belgium	
Type of Flight:	Public Transport	
Persons on Board:	Crew - 5	Passengers - 43
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to tail bumper	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	33 years	
Commander's Flying Experience:	3,680 hours (of which 480 were on type)	
	Last 90 days - 90 hours	
	Last 28 days - 24 hours	
Information Source:	AAIB Field Investigation	

History of flight

The flight crew stated that the aircraft was stabilised on the ILS approach to Runway 25L at the correct speed. The aircraft was fully configured for landing with 33° of flap selected and the landing gear down. The commander recalled that the N1 engine parameter was set to 53% whereas the first officer (FO) remembers it being about 50%. The weather was good with visibility greater than 10 km, no cloud below 5,000 feet and a steady surface wind, at the time of landing, from 330° at 13 kt.

The FO, who was the handling pilot, disengaged the autopilot at 215 feet agl and later deployed the airbrakes. The commander reported that the speed over the threshold was correct and that a flare was then initiated. Just prior to touchdown the FO considered that the rate of descent of the aircraft was higher than normal and, to counter this he selected a higher pitch attitude. The commander suspected that the rear of the fuselage then immediately struck the surface of the runway, with the main wheels and nose wheel touching down in turn. The speed at touchdown was reported as being 108 kt and it was estimated that the aircraft landed in the touchdown zone. The flight crew also reported that they heard the stall warning sound just before the aircraft touched down, and that it continued for a further two or three seconds. During the final stages of the approach the cabin crew had sensed the aircraft roll to the left just before touchdown and then land heavily. As the aircraft landed the crew felt a vibration through the airframe. The landing roll was completed without further incident and the aircraft was taxied on to its allocated stand and shut down. During an inspection of the aft end of the fuselage the commander discovered damage to the aircraft's tail bumper indicating that it had contacted the ground.

The aircraft's landing weight was calculated to be 31,000 kg, with an associated V_{REF} of 108 kt. The maximum landing weight was 36,740 kg. The CG was close to the middle of the permitted range.

Flight Recorders

Document title

The aircraft was equipped with a 25-hour duration flight data recorder (FDR) and a 30-minute duration cockpit voice recorder (CVR). The CVR recording of the incident landing was overwritten by more recent recordings and, as a consequence, the recording contained no information useful to the investigation.

The FDR was configured to record the time histories of 57 parameters. However, an undetected failure of a five-volt reference supply within the FDR resulted in 15 parameters not being recorded. The parameters not recorded included altitude, airspeed and all data on engine performance and control surface positions.

A plot of relevant data recorded during the approach and landing is at Figure 1.

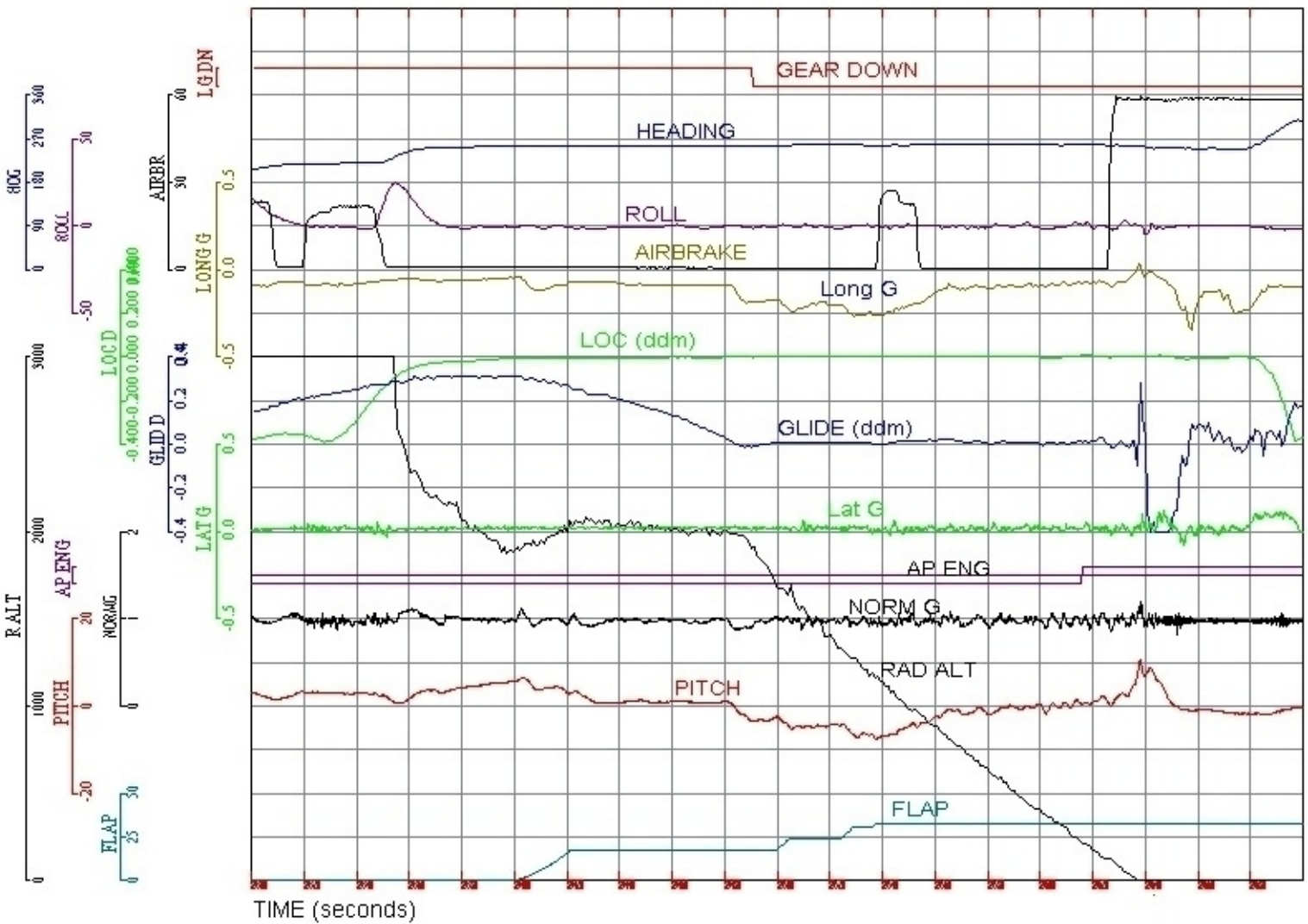


Figure 1

The absence of altitude, airspeed and engine parameters severely restricted the usefulness of the recorded data. The data that was recorded showed that the aircraft had captured the glideslope at 2,000 feet agl. As soon as the aircraft started to descend with the glideslope the landing gear was lowered. At 1,170 feet agl, after the final stage of flap had been selected, a little less than half of the available airbrake was deployed for a period of 16 seconds; the airbrakes were then restowed.

The autopilot was disengaged at 215 feet agl, 22 seconds before touchdown. At 125 feet agl the airbrake was deployed to 55° and remained in that position until the aircraft had landed. After the airbrake had been deployed the recorded pitch attitude increased, as did the rate of descent which, by 70 feet agl, had developed to about 900 fpm. In the final second before touchdown the pitch attitude increased rapidly and the rate of descent was reduced to about 300 fpm.

At touchdown the recorded pitch attitude was 10.6° nose up. Immediately after touchdown the pitch attitude was reduced to 7° as the aircraft began to roll to the left, reaching a maximum of 4.5° left wing down over the next four seconds.

Aircraft information

The manufacturer has advised that this aircraft type will suffer a tailstrike during landing if, with the landing gear extended, the pitch attitude is 12.6° or greater and a tail bumper is fitted. Without a tail bumper, the limiting attitude with the landing gear extended is 14.1°. If the landing gear is compressed, a pitch attitude of 8.4° or greater will cause a tailstrike in the region of Frame 38, with the tail bumper remaining clear of the ground by several inches.

Discussion

The aircraft's rate of descent increased following the deployment of the airbrake at 125 feet agl and by 70 feet agl it had developed to about 900 fpm. In the absence of the 15 parameters not recorded on the FDR it is not possible to say with certainty what might have contributed to this increase. However, the engine thrust recalled by the flight crew was set to a low value. The reported surface wind at touchdown was 80° to the right of the runway heading and steady at 13 kt. The FO initiated the flare after the aircraft had crossed the threshold and later made a more positive input on the controls, just prior to the aircraft landing, when he realised that the rate of descent was higher than normal. At touchdown the aircraft's recorded pitch attitude was 10.6° and the tail bumper struck the runway. The contact area and damage was limited to the tail bumper.

Information from the manufacturer, coupled with the pitch attitude recorded on the FDR, implies that the main landing gear contacted the runway surface fractionally before the tail bumper. It also suggests that contact between the aircraft skin, in the area of Frame 38, and the runway was narrowly avoided.

During the latter stages of the approach the rate of descent and the pitch attitude had both increased, whilst the aircraft maintained the glideslope with a low thrust setting. This suggests that the airspeed had reduced to a lower value than the flight crew had realised, and this low energy state is confirmed by operation of the aural stall warning.

Since this incident the operator has issued extra guidance to crews operating this aircraft type. This includes the need to monitor carefully the airspeed and power setting during the final approach and the need for pilots to consider a go-around when they are aware of a high sink rate during the flare, rather than increase the flare.

The Operator is also considering a review of the serviceability testing carried out on the type of FDR used in G-MANS to improve the probability of recovering all the parameters that are recordable.