

**No: 8/89**

**Ref: EW/C1103**

**Category: 1a**

**Aircraft Type**

**and Registration:** Boeing 747-131, N53110

**No & Type of Engines:** 4 Pratt and Whitney JT9D-7A turbofan engines

**Year of Manufacture:** 1970

**Date and Time (UTC):** 20 April 1989 at 1147 hrs

**Location:** Approaching London/Heathrow Airport

**Type of Flight:** Scheduled Public Transport

**Persons on Board:** Crew - 16 Passengers - 297

**Injuries:** Crew - None Passengers - None

**Nature of Damage:** Portion of No.16 Krueger (leading edge) flap damaged and further damage to flap, to leading edge of wing and to fuselage

**Commander's Licence:** Airline Transport Pilot's Licence

**Commander's Age:** 57 years

**Commander's Total Flying Experience:** 25,000 hours (of which 4,800 hours were on type)

**Information Source:** AAIB Field Investigation

The aircraft was on a scheduled public transport flight from Los Angeles to London/Heathrow with a total of 313 persons on board. Take off from Los Angeles was at 0122 hrs and the flight proceeded normally until approaching Heathrow with the commander flying a manual Instrument Landing System (ILS) approach to runway 09L. As the aircraft was turning onto the ILS centre line, and shortly after the flaps had been moved from 10 degrees to 20 degrees, a bang was heard to come from the right side of the aircraft with an accompanying light vibration throughout the aircraft. At the same time three flight stewardesses working the right side of the aircraft reported hearing a bang which they initially took to be a bird strike. There were no indications on the flight deck of any abnormality and the commander reported that he had no difficulty in controlling the aircraft. The landing was normal and the aircraft was taxied to the stand where the passengers disembarked without further incident.

The first indications to the flight crew of the nature of the damage was when the ground crew advised them of damage to the No.16 leading-edge Krueger flap (figure 1), adjacent to the No.3 engine. It was evident that this section of Krueger flap had been able to rise above its normal position and that the 'bull-nose' portion had scraped against the engine pylon; this caused a piece of the 'bull-nose' to break off and strike the fuselage about 10 feet forward of the R4 door, slightly penetrating the skin.

Subsequent examination showed that the extra movement of the Krueger flap had been initiated by the failure of the gimbal fitting (figures 1 and 2) which links the ballscrew transmission system, mounted in the wing, with the support arms of the Krueger flap. Following the failure of the fitting, the section of Krueger flap was free to move upwards and to allow the outboard section of 'bull-nose' to scrape against the engine pylon.

Detailed metallurgical examination showed a small area of fatigue cracking around an area of undercut on one of the side-plates : fatigue fracture in this Titanium material is characterized by an extremely small critical crack length and the side-plate then failed in rapid overload. The missing sections of the fitting and of the Krueger flap were not recovered.

The manufacturer has attributed past failures of this fitting to looseness or fracture of one or more of the 8 gimbal attachment bolts on each fitting (6 fittings per aircraft). The original attachment bolts were manufactured from H11 steel, which, according to the manufacturer and CAA Airworthiness Notice No.12, Appendix 35, is susceptible to stress corrosion.

This accident was almost identical to one on 11.2.88, reported in AAIB Bulletin 11/88, occurring to a British-registered 747-136, G-AWNA, on approach to Heathrow. Following that accident the operator of G-AWNA instituted a Special Check and the following steps:

- 1) replacement of the original (H11 steel) gimbal attachment bolts with their Inconel equivalent,
- 2) changing of all gimbal assemblies which the Special Check identified as having attachment bolt torque below 95 in-lbs and
- 3) amendment of the maintenance schedule to include a periodic torque check at Inter check frequency.

At the time of the accident to G-AWNA (11.2.88) the appropriate Service Bulletin was SB 747-27-2148, which simply required a one-time torque check on the attachment bolts. On 6.10.88, therefore, AAIB made two formal recommendations to the CAA:

- (i) that the CAA ensure that any future operator of 747-100 series aircraft institute similar procedures (see above) to that of G-AWNA's operator and
- (ii) that the CAA draw the attention of the FAA (Federal Aviation Administration) to the shortcomings of SB 747-27-2148.

On 23.11.88 the manufacturer issued Revision 3 to this Service Bulletin, specifying the use of

Inconel bolts as replacements for the existing (H11) bolts and recommending the replacement of all the existing bolts. The Revision does not, however, call for any repetition of the check. Following the accident to N53110 (20.4.89), therefore, AAIB repeated the two recommendations. These have been accepted by the CAA, who have asked the manufacturer and the FAA to improve the Service Bulletin and are processing a CAA Additional Airworthiness Directive to ensure compliance for all aircraft of this type on the British register.

