

No: 12/92

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Category: 4

Aircraft Type and Registration: Boeing 747-238B, G-VLAX
No & Type of Engines: 4 Pratt & Whitney JT9D-7J turbofan engines
Year of Manufacture: 1974
Date & Time (UTC): 15 June 1992 at 1709 hrs
Location: London Gatwick Airport
Type of Flight: Public Transport
Persons on Board: Crew - 19 Passengers - 329
Injuries: Crew - Nil Passengers - Nil
Nature of Damage: Damage to inboard flap and actuating rods
Commander's Licence: Airline Transport Pilot's Licence
Commander's Age: 57 Years
Commander's Flying Experience: 17,760 hours (of which 5,800 were on type)
Information Source: AAIB incident enquiries

The aircraft was operating a scheduled flight from Gatwick to Boston. Shortly after takeoff a passenger, who was seated near door R4, called the attention of a cabin attendant to parts of the inboard flap actuating mechanism which appeared to be 'hanging down'. The cabin attendant called the flight engineer who noted the damage and advised the operator's engineering base. No adverse effects or indications had been observed by the flight crew. The crew were advised to dump fuel and return, which they did. After dumping fuel the crew made a normal flap 25 landing, with no handling problems apparent.

Examination of the flap mechanism showed that right hand inboard trailing edge aft flap was jammed against the mid section. The damage was confined to the position 5 and 6 flap carriage mechanism, the number 6 canoe fairing and seal carrier, with extensive rubbing at the inboard end of the flap. Several of the flap carriage rods had fractured and some portions of the rods were missing. Metallurgical examination of the fracture surfaces showed that all had occurred in single overload, but one of the fracture surfaces was clearly older than the rest.

Following the incident, the right hand inboard trailing edge aft flap section was removed and a replacement fitted. Whilst attempting to refit the number 5 fairing, difficulty was encountered gaining

the correct rigging dimensions. Eventually the aircraft was despatched without the fairing (this is a permitted deficiency for despatch). Subsequent attempts at rigging the fairing, as described in the Maintenance Manual, failed to identify the cause of the problem. It was then decided to check rig the flap system even though the initial rig check was satisfactory. The problem was eventually traced to mis-rigging of the flap carriage shims, and following the correct adjustment of these, using Boeing engineering drawings, it became possible to rig the system correctly in accordance with the Maintenance Manual. It was also observed that the left hand inboard flap showed evidence of rubbing similar to that on the right side, and this was corrected.

The operator advised that in January 1990, when the aircraft was aquired, the flaps were removed and subsequently re-fitted. Also in May 1992, at the previous "C" check, the flap carriages at positions 3, 4 and 6 had been renewed. At this time the flap carriage at position 5 was removed and re-fitted to facilitate the change at position 6. The Maintenance Manual describes the re-fitting of the inboard flap and the fitting of shims to the flap carriage. These shims are supplied for two reasons: (i) they adjust the flap alignment and (ii) they take up the 'grip-length' of the specified bolts. Therefore adjustments are made by selecting some of the shims to go between the mid flap and the carriage, and the remainder of the shims go under the nut where they have no affect on the alignment, but maintain the standard grip length. The distribution of the shims is specific to the individual flap section. In most cases, however, all the shims are under the carriage, i.e. all of the shims are effective in adjusting the alignment. The Maintenance Manual also states that, following flap removal, if the shim settings are lost, the flap should be re-installed using the same shim arrangement found on the opposite hand flap on the aircraft. There is no guidance in the Maintenance Manual concerning establishing the correct shim thicknesses from scratch.

The operator considered that the most probable sequence of events was that when the flap carriages were re-fitted, the shim settings had been lost for both sides of the aircraft. Therefore it was not possible to fit the shims as advised in the Maintenance Manual. The flap carriages were therefore fitted with the shims arranged as commonly required, i.e. so that all of the shims were under the carriage. In the case of this aircraft this resulted in inadequate clearance on both left and right inboard flap assemblies. After a period in service the single rod failure occurred and a further period elapsed before the incident on the 15 June took place.

The operator noted that the Maintenance Manual made no reference to the importance of maintaining the correct shim positions. Boeing engineering drawing 65B00116 contains all the relevant rigging data and a chart showing the mid flap adjustment available, with the correct use of the shims.

As a result of these findings the AAIB makes the following Safety Recommendation:

92-89 In order to avoid mis-rigging of trailing-edge flaps on Boeing 747 aircraft during replacement of flaps when the associated flap carriage shim settings are unknown, the Boeing Airplane Company, in consultation with the FAA and CAA, should incorporate the information contained in Boeing engineering drawing 65B00116, relevant to the rigging of these shims at the mid flap, into the Maintenance Manual at paragraph 5 of ATA 27-51-01.

In response to a draft of this Safety Recommendation The Boeing Company has advised that it agrees with the recommendation and that section 27-51-01 of the Maintenance Manual is being revised and the revision is scheduled for release in December of 1992.