AAIB Bulletin No: 3/93 **Ref: EW/A92/9/1** **Category: 4**

INCIDENT

Aircraft Type and Registration:	Boeing 747-283B, G-VOYG	
No & Type of Engines:	4 Pratt and Whitney JT9D-7A turbofan engines	
Year of Manufacture:	1971	
Date & Time (UTC):	25 September 1992 at 0006 hrs	
Location:	Newark Airport, New Jersey, USA	
Type of Flight:	Public Transport (Scheduled passenger)	
Persons on Board:	Crew - 19	Passengers - 356
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to right wing leading edge and bleed air system	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	49 years	
Commander's Flying Experience:	17,017 hours (of which 4,733 were on type) Last 90 days - 76 hours Last 28 days - 49 hours	
Information Source:	AAIB Field Investigation	

During take-off from runway 04L at Newark Airport, a low amplitude vibration was felt on No. 3 thrust lever. Later and whilst climbing through about 4,000 feet, the 'right wing overheat' light illuminated. As required by the QRH drill, the right wing air ducting was isolated by closing the pylon, wing isolation and pack (ie air conditioning) valves. After two minutes the wing overheat light extinguished. However, at approximately 12,000 feet in the climb, and as the aircraft was accelerating from 250 kt to 330 kt, a severe 'jolt' was experienced which was described as comparable with an engine surge, although no such event was apparent from the engine instruments. Boston ATC were questioned as to the proximity of any other traffic, in case the jolt had been caused by a wake vortex encounter. Boston ATC advised that the flight was about 5 nm behind a Boeing 727, and the crew considered that this might have been the cause of the disturbance. Since no other problems were apparent the flight was continued to Gatwick, where the aircraft landed without further incident.

Subsequent examination of the aircraft showed that the honeycomb panels on the lower surface of the right wing leading edge, between the inboard (No. 3) pylon and the fuselage, were distorted and holed. The pressure relief panel, located near the fuselage, was in place. There was no apparent damage to the leading edge primary structure, or to the leading edge flap. It was found that the bleed air duct in the leading edge had separated due to fracture of a bleed air duct clamp. The damage to the leading edge honeycomb panel had been caused by the sudden release of bleed air when the clamp had failed. The pressure relief panel is intended to release excess pressure from a relatively slow bleed air leak, and is not designed to protect the structure from a rapid release of bleed air.

The failed clamp bore the part number 7540602. The bleed air duct sections themselves had not failed. This aircraft had suffered a similar incident on 13th June 1992, when a duct had failed in the left wing leading edge (AAIB Bulletin 10/92 refers). That failure was due to hydrogen embrittlement of an annular weld in one of the ducts, and resulted in similar secondary damage. At that time the requirements of FAA AD 91-06-08, which called for inspections and heat-treatment of the ducts, had not been carried out on this aircraft, since it had not reached the airframe cycles threshold of that AD, or the associated Boeing Service Bulletin 747-36A2074. Following that incident, all the bleed air ducts in the leading edges were removed, inspected and heat-treated in accordance with the requirements of AD 91-06-08. When the ducts were refitted, the existing duct clamps were re-used, as permitted by the AD.

Metallurgical examination of the failed duct clamp, which had caused this later incident, showed that it had suffered a fatigue-initiated fracture emanating from a radius in a lug at the hinge. There are four such lugs on each clamp, and some fatigue was also found in one of the lugs on the opposite side of the hinge. Some of the fatigued area appeared to be 'old', however final failure had occurred in a relatively small number of cycles. The other clamps on the same aircraft were examined, using magnetic particle techniques, and this identified three other clamps of the same type which had similar cracks.

The Boeing Company advised that 10 fractures of this clamp were on their records, half of these having occurred after the requirements of the AD and Service Bulletin had been accomplished. The fractures were attributed to clamp pre-load and Boeing advised that care must be taken to ensure proper alignment of the ducts during installation. A redesigned clamp, part number 7541751, was introduced into production in 1972, and no failures of the new clamp have been reported to Boeing. The availability of these clamps was promulgated in the vendor's Field Service Bulletin FSC912, dated December 1972; however there was no associated requirement to remove old clamps from service.

In an earlier incident to a British operated Boeing 747 (G-AWNL) on 19 March 1991, the failure of a clamp of the same part number (7540602) had occurred shortly after rotation during take-off from runway 27R at Heathrow (AAIB Bulletin 8/91). The clamp was fitted at the No 3 inboard pylon location and its failure resulted in damage to the fuel and hydraulic systems, and severing of the generator feeder cables and engine parameter cables from the No. 4 outboard engine. As a result of the findings associated with that incident, and information on a fire within the same zone above a No. 2 pylon on a North West Airlines Boeing 747-400 on 19 September 1991 (Bulletin Addendum 6/92) which had been caused by 'chafing' of a generator cable against a fuel pipe with arcing-induced holing of the fuel pipe, the AAIB made three Safety Recommendations which called for fire detection and fire resistant fuel/hydraulic pipes in such zones; and a regulatory review of the design features of similar zones on other types of public transport aircraft with wing pylon mounted engines. However, the CAA did not accept any of these Safety Recommendations, but stated within its response:

> *"The introduction of a more reliable pipe clamp as recommended by Boeing and already implemented by British Airways would therefore appear to be the more sensible approach. The Authority will investigate this further with the FAA and consider whether mandatory replacement is appropriate. A review of our records, however, show no previous incident where a duct clamp failure has caused serious secondary damage to adjacent systems and equipment."*

and *"A review of the Authority's SDAU records indicates that these types of event do not represent a significant airworthiness problem for the Boeing 747 or any other type of large public transport aeroplane.*

> *The Authority therefore believes that a more extensive investigation of other aircraft types would not be justified and proposes no further action in this respect."*

Notwithstanding this regulatory response, the AAIB remains concerned about the potential for, and the consequences of, undetected fire initiation within such zones of both wings and continues to support the three previous Safety Recommendations numbers **92-17**, **92-18** and **92-19**.

Furthermore, in view of the findings associated with this latest incident to G-VOYG, the AAIB makes the following additional Safety Recommendations:

93-1 The CAA, in consultation with the FAA and the aircraft manufacturer, should require the mandatory replacement of air duct clamps part number 7540602 with redesigned clamps to part number 7541751 on all Boeing 747 aircraft, in zones where fuel pipes are present, in order to reduce

the incidence of clamp failure and possible critical secondary damage effects upon fuel, hydraulic and electrical systems. (Issued 22 February 1993)

93-2 The CAA, in consultation with the FAA and the aircraft manufacturer, should actively consider requiring the mandatory replacement of air duct clamps part number 7540602 with redesigned clamps to part number 7541751 in all other locations of the Boeing 747 aircraft where such clamps are used. (Issued 22 February 1993)