No: 8/91 **Ref: EW/G91/03/10** **Category: 4**

Aircraft Type and Registration:	Boeing 747-136, G-AWNL	
No & Type of Engines:	4 Pratt & Whitney JT9D Turbofan Engines	
Year of Manufacture:	1972	
Date & Time (UTC):	19 March 1991 at 1152 hrs	
Location:	Runway 27R, London Heathrow Airport	
Type of Flight:	Public Transport	
Persons on Board:	Crew - 19	Passengers - 378
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to leading edge bleed air duct at No. 3 engine position	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	43 years	
Commander's Flying Experience:	5,380 (of which 1,156 were on type)	
Information Source:	Information supplied by the operator and AAIB enquiries	

This incident is the subject of a CAA Mandatory Occurrence Report investigation and is not a Reportable Accident under the Regulations, however the circumstances of the incident were such that the AAIB elected to make enquiries and to publish this bulletin.

The aircraft was on a scheduled flight from London Heathrow to Miami International and its weight was close to the maximum permitted for take off (332,900 kg). During the take-off run on runway 27L and just after the decision speed V1, a loud 'bang' was heard followed by severe vibration from all four thrust levers. The take-off was continued and the aircraft rotated normally at Vr and entered the climb. The landing gear was not immediately retracted due to the possibility of burst tyres, however shortly after the aircraft became airborne the No. 4 engine generator failure warning lights illuminated, the engine oil temperature indication decreased off-scale and the exhaust gas temperature (EGT) also reduced to a low reading. Suspecting an engine failure, the commander ordered the landing gear to be retracted. However, since the No. 4 engine N1, N2 and fuel flow indications remained normal, the commander decided not to shut down the engine. As the aircraft climbed through 500 feet, the right wing overheat warning light illuminated. At a safe height the flaps and

leading edge lift devices were retracted, control was transferred to the co-pilot and the flight engineer, monitored by the commander, completed the wing overheat and single generator inoperative check lists. Whilst these were being completed Heathrow ATC advised that debris had been found on the runway. The commander decided to return to Heathrow and radar vectors were requested for fuel jettison.

Fuel was jettisoned, at FL 120 in the Barkway VOR holding pattern, down to an aircraft weight of 265,000 kg. The commander decided to test the fire warning system for all 4 engines as a precautionary measure and it was found that the No. 4 engine "B" fire detection loop was unserviceable. "A" loop was therefore selected. The Descent and Approach checks were completed. Following a wing overheat drill it is necessary to deploy the leading edge flaps by the 'Alternate' procedure. When this was carried out the right hand leading edge outboard (No. 1) flap did not deploy. The 'one or more leading edge flap fails to extend' check list was therefore completed and the airspeed bugs reset at Vref+20. Medium auto-brake was selected for landing. The commander carried out an auto-coupled approach and manual landing on runway 27L. As the aircraft was parked at the stand, two brake overheat lights associated with the right bodygear wheels illuminated. The wheels were monitored by the Airport Fire Services, who were already in attendance. The passengers and crew vacated the aircraft through the normal channels.

Subsequent examination of the aircraft showed that a failure had occurred in the 7 inch diameter flexible duct joint retainer which secures the No. 3 engine nacelle strut pneumatic "tee" duct to the inter-engine leading edge duct. This had resulted in the detachment of three 'blowout' panels which were the "debris" reported by ATC. The duct joint retainer was in close proximity to the electrical loom from the No. 4 engine sensors, in addition to the No. 4 generator field and feeder cables. These looms had suffered damage and the generator feeder cables had been severed. In addition, debris released by the blowout had struck and dented the No. 3 engine aluminium alloy fuel supply pipe and one of the two large hydraulic pipes in this area. This zone is not equipped with either fire detection or suppression equipment, and the fuel pipe construction changes from aluminium alloy to steel where it exits the zone and enters the pylon. The two pressure and return hydraulic pipes in the zone are constructed in steel and aluminium. This zone, on an aircraft similar to 'NL, is shown in Figure 1 with the relative locations of the air duct, adjacent loom and aluminium alloy fuel pipe indicated in Figure 2.

The flexible duct joint retainer was found to have failed at one of the two "tee" bolt securing lugs some time prior to the failure of the second lug which initiated the incident. It is believed that distortion of the retainer had occurred during fitment. The retainer was of a type which is commonly fitted to earlier B747 aircraft and has a history of defects, and had become the subject of a replacement programme

prior to this incident (Mod. 36D059). This programme has been given an increased priority by this operator who has also issued instructions for inspections of earlier aircraft, including other areas of ducting which utilise identical couplings. The operator commented that a vendor's Service Bulletin had been available on this subject for some time, but had not been received prior to the incident.

The AAIB has discussed a number of fire safety issues raised by this incident with the CAA and Boeing. In particular, the introduction of mechanical protection for the aluminium alloy fuel and hydraulic pipes has been discussed. Boeing have advised that the zone is a flammable fluid zone, not a fire zone, because no ignition source exists in the area. However, it is notable that the No. 4 engine generator feeder cables pass through this zone and had been severed. Boeing are aware of 8 previous failures of similar early standard retainers, usually due to incorrect installation. The later standard of retainers have no similar history. The CAA evaluation of this zone is continuing and when the associated results are available the AAIB will consider the need for any appropriate Safety Recommendations.

Figure 1

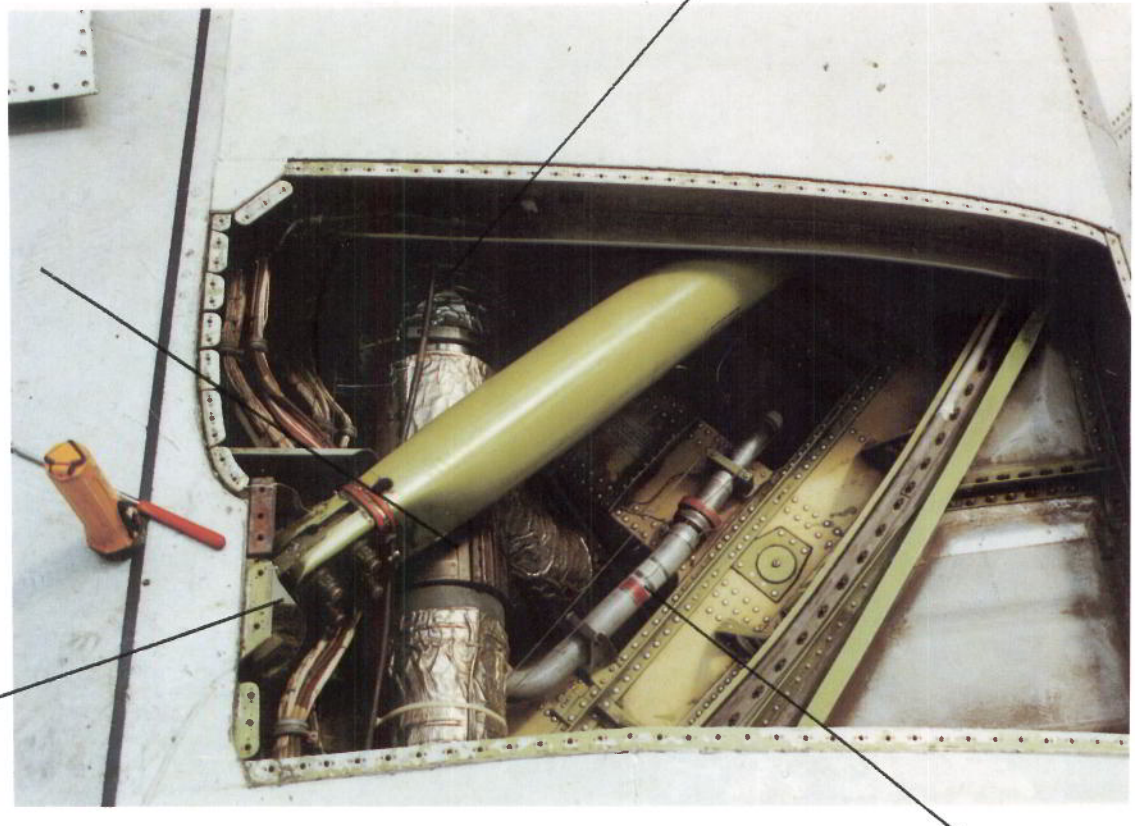

Figure 2