

## ADDENDUM

Ref: EW/G91/03/10

### INCIDENT TO BOEING 747-136, G-AWNL ON 19 MARCH 1991 AT LONDON HEATHROW AIRPORT

AAIB Bulletin 8/91 reported the details of the above incident, which were briefly as follows:

During take-off, a 'bang' was heard and vibration felt. Shortly afterwards the No. 4 generator failure warning light illuminated and the No. 4 engine oil temperature and exhaust gas temperature (EGT) indications dropped to zero, although N1, N2 and fuel flow remained normal. At some 500 feet after take-off the right wing overheat light illuminated. The wing overheat and single generator inoperative checklist actions were carried out. The fire detection system was then tested and 'B' loop for the No. 4 engine was found to be unserviceable. Fuel was dumped and the aircraft returned to Heathrow. During the approach the leading edge flaps were deployed by the 'Alternate' procedure, however the right hand outboard flap failed to extend. The approach was made at  $V_{ref} + 20$  knots in accordance with the appropriate procedure and the aircraft landed without further incident. Three pylon 'blowout' panels had been found on the runway.

Examination of the aircraft showed that a bleed air duct failure had occurred in the right wing leading edge, adjacent the No. 3 pylon. The duct had separated due to the failure of a clamp securing the 'tee' junction where the engine bleed duct joined the inter-engine duct. The duct clamp had failed with sufficient force to damage the No. 4 engine parameter sensor cables and sever the No. 4 generator feeder cables. This clamp failure had also caused impact damage to the aluminium alloy fuel pipe which supplied the No. 3 engine, and a large diameter aluminium alloy hydraulic (return) pipe. 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 Bulletin stated that the clamp had been of an early design standard which was the subject of a replacement programme. The AAIB asked CAA to re-evaluate this zone, designated a 'Flammable Fluid Zone', in the light of this incident and pending possible AAIB Safety Recommendations.

However another incident subsequently occurred on 19th September 1991 which was considered of relevance. A Boeing 747-400 of a foreign operator departed Narita Airport and was climbing through 25,000 feet when multiple central warning system (CWS) warnings occurred which were mostly associated with the No. 1 engine, but included a bleed duct overheat warning. Pressurisation was lost and the aircraft returned to Narita. During the landing roll, the tower controller advised that the No. 2

pylon was on fire. The crew had received no fire warnings or indeed any warnings concerning the No. 2 engine. An evacuation was carried out, in torrential rain, and a number of injuries occurred.

The cause of this second incident is under investigation by the Japanese authorities but it has been reported that the No. 1 generator feeder cable 'chafed' against the fuel feed pipe and this had caused 'arcing' and holing of the fuel pipe. As a result of this occurrence, the FAA issued an Airworthiness Directive requiring checks on the security of the associated cables and clearance from the adjacent fuel feed pipe.

In the light of these two incidents, the AAIB has formed the view that the close proximity of fuel, hydraulic, bleed air and electrical systems in such zones creates the potential for several modes of failure, and that damage to adjacent systems is then likely. Any combination of failures or damage which involves electric looms and fuel or hydraulic fluid lines could result in fluid-fed fires in such zones which have no fire detection systems. The history of bleed duct failures indicates that such failures may occur from time to time. The AAIB has therefore made the following Safety Recommendations:

- 92-17** The CAA, in consultation with the FAA and the aircraft manufacturer, should require that the aluminium alloy fuel and hydraulic pipes in the four wing leading-edge/pylon zones of the Boeing 747 type be replaced by pipes constructed from materials which meet the fire resistance requirements applicable to designated Fire Zones. The material specification and dimensions of the pipes should be such as will enhance the ability of these pipes to withstand external mechanical impact and abrasion.
- 92-18** The CAA, in consultation with the FAA and the aircraft manufacturer, should require that the fire detection system on the Boeing 747 type be extended to include the wing leading-edge/pylon zone.
- 92-19** The CAA, in consultation with the appropriate airworthiness authorities and manufacturers, review other large public transport aircraft types with pylon mounted engines to determine if similar action is required.

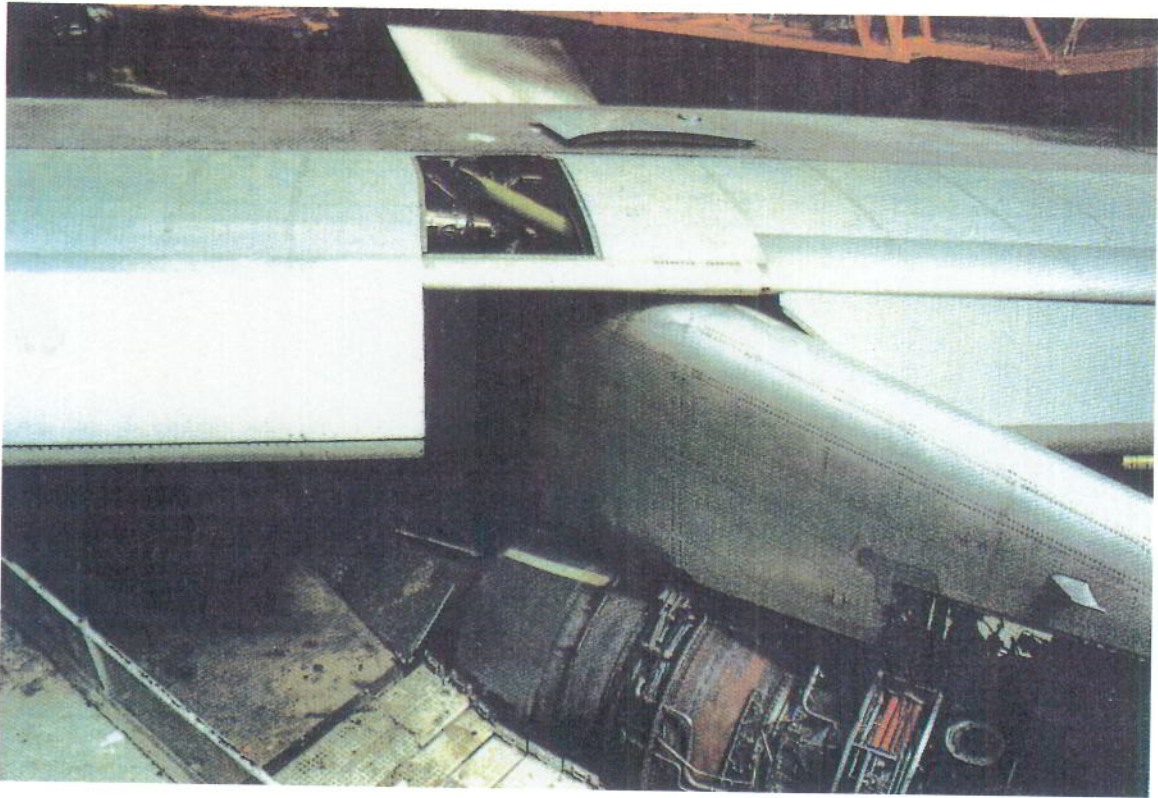


Figure 1

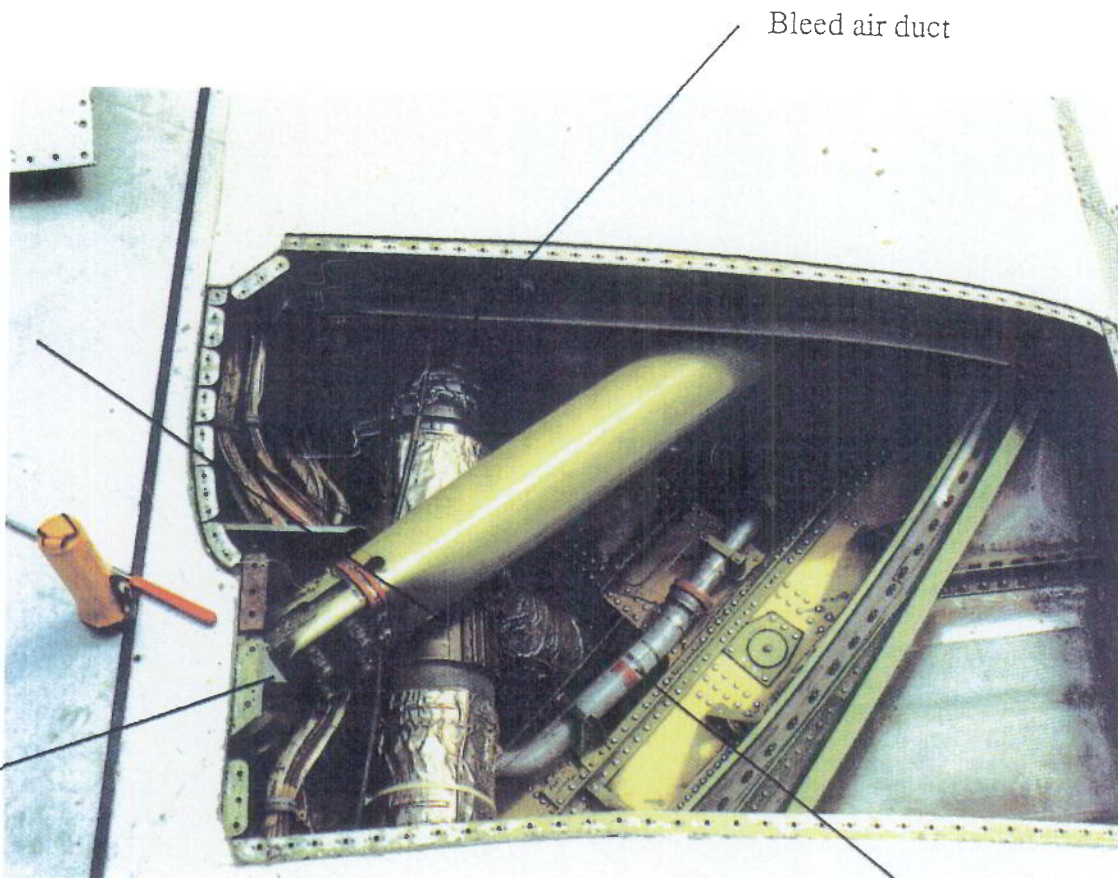


Figure 2

Fuel pipe