

INCIDENT

Aircraft Type and Registration: Boeing 747-436, G-BNLL

No & Type of Engines: 4 Rolls-Royce RB211-524G2-19 turbofan engines

Year of Manufacture: 1990

Date & Time (UTC): 28 March 1995 at 0231 hrs

Location: Seoul, South Korea

Type of Flight: Scheduled Passenger

Persons on Board: Crew - 20 Passengers - 383

Injuries: Crew - None Passengers - None

Nature of Damage: Slight fire damage to No 4 engine core fairings

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: N/K

Commander's Flying Experience: 15,215 hours (of which 2,100 were on type)
Last 90 days - 126.5 hours
Last 28 days - 41.5 hours

Information Source: AAIB Field Investigation

Shortly after takeoff from Runway 32R at Seoul, there was a fire warning from the No 4 engine. The crew executed the fire drills, extinguishing the warnings, and, after dumping 106 tonnes of fuel, landed uneventfully back at Seoul. An inspection by ground engineers, monitored by the airline's powerplant engineering section, revealed some fire damage to the core engine fairing panels and sooting of the core engine around the aft end of the high pressure compressor. It was decided to investigate the problem in the UK and so the fan blades of the No 4 engine were removed, the core engine blanked and the aircraft ferried, non-revenue, back to London Heathrow.

The engine was removed from the aircraft and the core fairing panels and thrust reverser duct removed. This revealed that the fire damage was most severe in the arc between 6 and 9 o'clock as viewed from the rear of the engine, but that there was some evidence of the effects of fire around most of the circumference of the core engine, in the zone of the aft end of the HP compressor and the fuel manifolds. There was also some smoke blackening around the core engine support stays and the fire detection system wiring inside the core fairing was damaged.

Initial inspection had shown that the wirelocking of all the pipe union nuts of the high pressure fuel system within the core fairing were intact and in the correct sense. The wirelocking was removed and the torque tightness of all union nuts recorded. This revealed that one union, from the manifold to the one of the six pigtails (triple branched burner nozzle feed pipes) adjacent to the position of the greatest evidence of fire, was loose; being tightened to only 30 lb.inches torque rather than the required 250 lb.inches. All other unions on the high pressure fuel system in this zone were found to have been correctly tightened.

The union nut was restored to its position before the torque check was done and a leak test performed. This showed that there was a fuel leak from the joint which started when the pressure was raised above 200 psi. When the joint was tightened up to the correct torque it did not leak, even at the maximum achievable fuel pressure of 1400 psi. This particular pigtail had been changed in May 1993, whilst the engine was on the wing; since when the engine had run 10,369 hours with 1,365 starts.

The operator instituted a search of their records to identify any other fuel manifold disturbances which had occurred whilst the engines were fitted on aircraft. All the affected engines were subjected to a special inspection to check the torque tightness of the fuel system unions and for fuel leaks from the manifold system. They are also formulating a new, duplicate inspection procedure for the torque tightening of the critical high pressure fuel connections on the engine.

Note damaged wiring loom

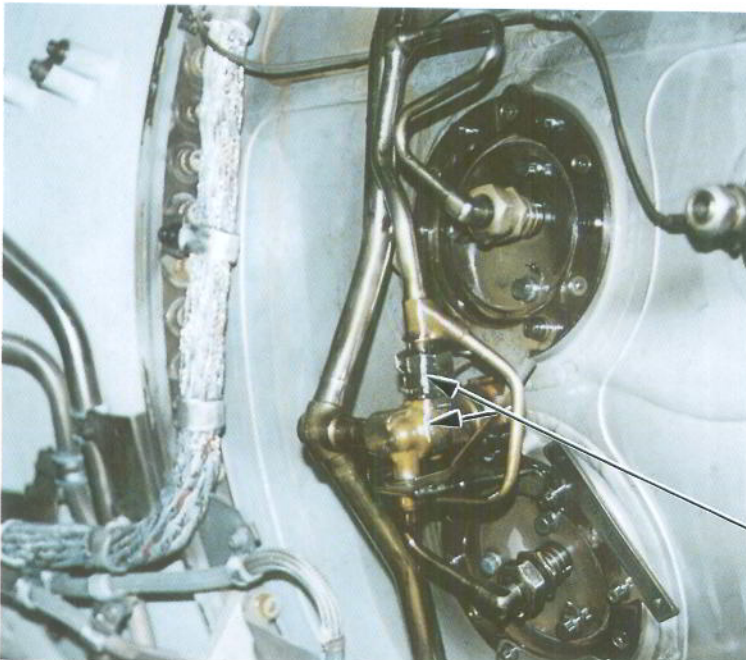


Fig 1a Union nut after tightening to correct torque

note changed position of line on nut relative to that on manifold

Union nut found to be undertightened

White line on nut and manifold show position of nut as found.

Figure 1 Combustion Case detail on right side of engine