



Serious damage to the No 2 engine had resulted with metal spatter being deposited on the walls of the jet pipe.

Following a borescope inspection of No 1 engine, temporary repair to the Green hydraulic system and replenishment and test of both Green and Yellow systems, the aircraft was ferried on three engines to LHR for a more detailed examination and repair. No hydraulic systems problems occurred on this flight.

Close examination of the two bolt tails recovered from the ramp actuator revealed both to exhibit characteristics of fatigue, one bolt showing relatively high cycle fatigue over most of the fracture, the other low cycle fatigue over approximately half the section. The failure planes were coincidental with the root of the first full depth thread close under the bolt head.

The ramp actuator is essentially a double ended screw jack, operating various linkages to the ramp doors, powered at any time by one of two separate hydraulic motors, Green and Yellow in the case of Engine No 2. Each motor is provided with a brake unit to prevent it from creeping when not under power, the brake being spring loaded to the "ON" position. When the unit is commanded to move the brake is taken off by hydraulically energising the brake piston with full system pressure, which in turn acts mechanically on the brake lever. Thus on each occasion the brake is operated the piston cover, and hence the two bolts, receive a loading cycle. Loss of the piston and cover will automatically allow hydraulic fluid to vent overboard. The number of cycles in any flight is not known as the ramp positioning system is an active system and will continuously respond to changing flight conditions.

A similar failure occurred to a French operated Concorde in 1982, where the No 2 engine had ingested the two bolt heads. On that occasion the cover and piston were retained by wedging against the brake lever. Following this event a Service Bulletin was issued by the actuator manufacturers and brought to the attention of operators by a Concorde Support Division Service Letter. As further failures were considered possible if no remedial action were taken, two alternative courses of action were recommended. Either to replace the bolt retaining plate or, to replace the bolts with new existing standard items at every workshop visit. This second option had been adopted on G-BOAD.

Following this incident the operator has elected to replace all the bolts with the improved fatigue strength items and to fit bolt retaining plates. The actuator manufacturer is also reported to be re-examining the validity of the Service Bulletin as it was originally thought the piston and cover would always be retained in the event of bolt failures.

Examination and functional testing of the Green and Yellow hydraulic systems revealed a small external leak at an expansion joint in Yellow system, which could have produced the observed slow loss of that system's contents. However, no reason was discovered for the sudden decrease when the undercarriage was deployed at Shannon. Replacement of change-over selectors in the undercarriage system marginally reduced the internal leakage in Yellow and, following further exhaustive testing, the aircraft was returned to service.

During Concorde's time in airline service there have been 23 reported occasions when, following the loss of a primary hydraulic system (Green or Blue), a fault in the stand-by Yellow system has been uncovered. On several of these occasions no direct fault was traced within Yellow system. Improvements are currently being incorporated to the hydraulic systems, mainly in the form of seal replacement using a material better able to withstand the prolonged temperature soak experienced by the aircraft.