

# Boeing 747-436, G-BNLT

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|----------------------------------------|-----------------------------------------------------------------------------------------------------|-------------|-----------------------|------------------|------------|
| <b>AAIB Bulletin No:</b>               | <b>11/2000</b>                                                                                      | <b>Ref:</b> | <b>EW/G2000/06/20</b> | <b>Category:</b> | <b>1.1</b> |
| <b>Aircraft Type and Registration:</b> | Boeing 747-436, G-BNLT                                                                              |             |                       |                  |            |
| <b>No &amp; Type of Engines:</b>       | 4 Rolls-Royce RB211-524G2-19 turbofan engines                                                       |             |                       |                  |            |
| <b>Year of Manufacture:</b>            | 1991                                                                                                |             |                       |                  |            |
| <b>Date &amp; Time (UTC):</b>          | 23 June 2000 at 0630 hrs                                                                            |             |                       |                  |            |
| <b>Location:</b>                       | London Heathrow Airport                                                                             |             |                       |                  |            |
| <b>Type of Flight:</b>                 | Public Transport                                                                                    |             |                       |                  |            |
| <b>Persons on Board:</b>               | Crew - 16 - Passengers - 295                                                                        |             |                       |                  |            |
| <b>Injuries:</b>                       | Crew - None - Passengers - None                                                                     |             |                       |                  |            |
| <b>Nature of Damage:</b>               | None                                                                                                |             |                       |                  |            |
| <b>Commander's Licence:</b>            | Airline Transport Pilot's Licence                                                                   |             |                       |                  |            |
| <b>Commander's Age:</b>                | 51 years                                                                                            |             |                       |                  |            |
| <b>Commander's Flying Experience:</b>  | 14,000 hours (of which 1,200 were on type)                                                          |             |                       |                  |            |
|                                        | Last 90 days - 143 hours                                                                            |             |                       |                  |            |
|                                        | Last 28 days - 40 hours                                                                             |             |                       |                  |            |
| <b>Information Source:</b>             | Aircraft Accident Report Form submitted by the pilot and subsequent telephone enquiries by the AAIB |             |                       |                  |            |

## History of the flight

During final approach into London Heathrow (LHR), at the end of a scheduled passenger flight from New York, a 'strong smell of equipment overheating' and a 'fine whitish smoke' were experienced on the flight deck when the aircraft was at about 2,000 feet agl. The crew suspected that the flight deck humidifier was the source of the problem and switched it off immediately. The autopilot was then engaged and the crew donned their oxygen masks. The smoke did not appear to increase as the approach was continued and Air Traffic Control was informed of the flight deck smoke problem as the aircraft descended through about 500 feet agl. After landing, the aircraft was met by the Airport Fire Service vehicles as it turned off the runway and escorted to its stand.

## Humidifier system

The aircraft was fitted with two humidifiers, which generate atomised water sprays to improve air quality in cruising flight. One of these supplied the flight deck and the other supplied the crew rest area at the rear of the cabin. The flight deck humidifier atomised water spray is introduced into the

flight deck through its air conditioning ducts. The spray is produced by a rotating, vaned disc, driven by a three-phase, 115 volts AC motor. Water is drawn, through an aspiration tube, from a chamber at the base of the unit. The flight deck humidifier system should only operate during the cruise phase of flight when the flight deck would be subject to dry conditions. The operation of the humidifier is automatically controlled by a solid state switch within the Environmental Control System (ECS) Miscellaneous printed circuit card. For the unit to operate, the system logic must sense 'sufficient airflow' (in the air conditioning ducts) and 'cruise clamp' (indicating that the aircraft is in cruise flight phase). Identification of the cruise flight phase is taken from the Flight Management System (FMS). The system logic should automatically disable the humidifier either by 'descent detect' or 'two hours prior to descent', using associated signals from the FMS.

### **Examination of the flight deck humidifier**

The flight deck humidifier was removed for investigation by the operator's engineering department. This particular aircraft has a history of humidifier removals and excessive moisture production. No evidence of overheating was reportedly found when this unit was examined in the operator's workshop, which was apparently frequently the case when such units were returned for similar suspected defects. It was therefore considered that the 'smoke' reported may have been associated with continued operation of the unit during the approach, producing excessive moisture in an already humid atmosphere. This assessment, however, did not appear to provide any explanation for the 'smell of equipment overheating' reported by the commander.

### **Action by the operator**

As a result of the above findings and assessment by the operator, the ECS control card was changed. However another incident of reported smoke on the flight deck occurred later on 5 July 2000. After this second incident, the humidifier system was locked out.

### **Improved humidifier motors**

Although humidifiers have had a reputation for unreliability this incident appeared unrelated, on the basis of this operator's workshop findings, to a series of incidents in 1996, reported in AAIB Bulletins 3/96 and 9/96, which resulted in Safety Recommendation No 96-62. This recommendation focused on the problem of motors overheating and generating smoke. The FAA responded to this recommendation by stating: 'We recognise that these units are unreliable, but loss of function of these units alone does not represent an unsafe condition. We are satisfied that the relatively low number of smoke/fume events does not warrant airworthiness directive action. The design changes currently being incorporated by [the manufacturer] will improve overall reliability and will prevent the resultant smoke and fumes on the cockpit.' The FAA therefore classified the recommendation as 'Closed - Acceptable Alternate Action'.

The humidifier manufacturer subsequently issued a Service Bulletin (M01AB-21-07) dated 5 February 1999. This introduced a new motor, equipped with three automatic reset snap thermoprotectors, one on each phase of the motor.

### **Humidifier replacement with Ozone converters**

The operator of the incident aircraft had intended to progressively replace these humidifier motors with the improved motors across the fleet as humidifiers were returned to the workshop, however

subsequent to this incident the operator has decided to remove all humidifiers from this fleet and to replace them with Ozone converters.