Boeing 747-136, G-AWNB, 19 February 1996

AAIB Bulletin No: 7/96 Ref: EW/C96/2/1Category: 1.1

Aircraft Type and Registration: Boeing 747-136, G-AWNB

No & Type of Engines: 4 Pratt & Whitney JT9D-7turbofan engines

Year of Manufacture: 1970

Date & Time (UTC): 19 February 1996, at approximately1411 hrs

Location: Aircraft parking bay T9, London Heathrow Airport

Type of Flight: Public Transport

Persons on Board: Crew - 18 Passengers - 348

Injuries: Crew - None Passengers - None

Nature of Damage: No 1 engine was removed to be examinedfor thermal shock effects following the use of water to extinguish

the fire

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: Not applicable

Commander's Flying Experience: Not applicable

Information Source: Aircraft Accident Report Form submittedby the pilot

History of the Incident

The aircraft had originally been tasked to operate a scheduledservice to Chicago on the previous day but had been withdrawnfrom service when a fuel leak was found close to the junctionof the No 2 engine pylon and the wing. After rectification, theaircraft was returned to service and tasked to carry out a scheduledservice to New York Kennedy Airport. The fuel load for the flightwas 122.2 tonnes and this had been originally uplifted for theChicago service.

The weather conditions included a surface wind of 010°/10kt, with reported gusts up to 30 kt, temperature 3°C andvisibility of 30 kms. Passenger boarding was carried out throughgate T9 at Terminal 4 and engine start was to be accomplishedin the standard order of Nos 4, 1, 2, 3 during aircraft push-backinto taxiway block 121/120. At the completion of the push-backthe aircraft was facing north-east with the wind coming from itsfront left quarter. Engine starting was conducted using fuelenrichment due to the low temperature and No 4 engine startednormally. No 1 engine did

not start on the first two attempts,therefore the ignition circuit breakers were pulled and resetby the crew. The third start attempt was successful. Nos 2 and3 engines were then started without further difficulty.

On completion of the push-back the tug was disconnected from theaircraft but remained in the vicinity until the engine startswere completed. Prior to leaving the aircraft, the dispatchingground engineer noticed an apparent fuel leak from the No 2 enginepylon, so he requested assistance from the engineering controlwho sent the duty ground engineering supervisor to the aircraft. At 1419 hrs the flight crew informed Ground Movement Control(GMC) of a problem and asked if they could remain on the taxiwaywhilst an inspection was made. On examination, the ground engineeringsupervisor observed a running leak, which he confirmed as fuel,coming from the No 2 engine pylon and flowing via the wingleading edge to the wing under surface and from there to the fuselageunderbody fairing and the left-hand body-gear doors. He advisedthat the engines should be shut down and the aircraft towed backonto Stand T9 to allow further engineering investigation. At1429 hrs the crew advised GMC that they were returning to StandT9.

When the aircraft had been repositioned onto the stand, the engineeringsupervisor approached from the direction of the tail and saw thatthere was a fire in the jet-pipe of No 1 engine. The effect ofthe gusting wind was to blow the flames forward through the intakeand laterally in the direction of the No 2 engine. This informationwas passed to the flight crew who were advised to ground motorthe engine to blow out the fire. The flight crew had been unawareof the fire because the engine fire detection system is designedto detect a fire within the engine cowlings and does not havefire detectors in the area of the jet-pipe. At about 1433 hrs,as the fire had not been extinguished, the engineering supervisorrecommended to the flight crew that they request the assistanceof the Aerodrome Fire Service (AFS) and continue to dry motorthe engine until assistance arrived. The AFS, alerted by ATCat 1434 hrs, arrived at the aircraft at 1437 hrs.

The commander next advised his company operations control thathe wished to evacuate his passengers through the airbridge; hedid not want to use the aircraft door slides because this wouldplace the passengers on the ground in a hazardous area. The hazardcomprised the fire in No 1 engine jet pipe and the pooled fuelon the ground from the leak in No 2 engine. Prior to this callfrom the flight crew, the airline operations control had advisedthe dispatcher, who had been responsible for the departure ofthe flight, that the aircraft was returning to the stand and shewas to attend to its requirements. When she arrived back at thestand the ground crew signalled to her that she was to positionthe jetty back to the aircraft door. She confirmed this by goingdown to the apron and speaking to the ground crew and then returnedto the jetty and drove it up to the Ll door of the aircraft.

In the meantime, a two-man 'Checker' team from the Airfield OperationsSafety Unit (AOSU) had arrived at the parking area having heardthe call for the AFS on the GMC radio frequency. AOSU is a unitof HAL, which is a company within BAA plc. AOSU provides inspectionand monitoring teams for the runways, taxiways, and apron areas;it provides a bird dispersal team and when necessary providesaircraft marshallers. The role of AOSU in an aircraft incidentis to lead local authority services to the scene, and to assistwith passenger handling. Its principal function is best describedas ensuring that the emergency services can carry out their dutieswithout impedance. They were immediately approached by the engineeringsupervisor who asked them to ensure that the AFS had been notified. One of the team confirmed that the fire service was on its way. He then instructed that the rear of the apron should be keptclear to allow access by the AFS and that the jetty should bekept clear of the aircraft. The engineering supervisor then wentup into the jetty and told the dispatcher that Heathrow AirportLimited (HAL) personnel (ie 'Checker') had instructed

that thejetty was to be kept clear of the aircraft. Having received thisinstruction, the dispatcher drove the jetty away from the aircraftonce more. She then contacted her operations controller on theinternal telephone system, which was available in the jetty, andasked what was happening. The controller told her to put thejetty back to the aircraft as the commander wished to evacuatehis passengers. Once the jetty had been repositioned at the L1entrance, the dispatcher opened the aircraft door in preparationfor the evacuation. By this time a police constable had arrivedin the jetty and so the dispatcher instructed him to lead thepassengers up into the terminal building arrivals level. Someof them had arrived there before the remainder were met by theTerminal Duty Manager, who took over the direction of the passengers,and led the way to the departures lounge. The subsequent evacuationof the aircraft was orderly and calm and there were no injuriesto passengers or crew.

Safety Recommendations

The following safety recommendations are made:

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The CAA, in consultation with the HSE, should make a formal assessmentof the use of airbridges for the purposes of an emergency evacuationwhile an aircraft is parked on a stand. The assessment shouldconsider the safety aspects in the light of existing and proposedairworthiness requirements together with the arrangements forthe handling of passengers in airside and landside areas. Appropriateguidance should be issued to airport users.

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The CAA should consult with aerodrome operators, airport usersand handling agents on the appropriate duties of handling agentsduring passenger boarding until such time as the aircraft movesoff under its own power and during passenger disembarkation. Manuals and Emergency Orders should define the precise periodof responsibility that exists towards a flight. The provisionof adequate communications between all the agencies involved shouldbe ensured.

Engineering investigation

The fire in No 1 engine had been seated in the jet pipe and didnot cause any damage to the aircraft. The engine was removedto be examined for thermal shock effects following the use ofwater to extinguish the fire. The fire may have resulted fromthe presence in the hot section of the fuel residue from the twofailed starts. Two components, the Fuel Condition Actuator (FCA)and the Fuel Pressurising/Dump Valve, whose malfunction couldhave caused an excess of residual fuel on shut-down after thefailed starts, were removed for investigation and no abnormalitieswere found during their test and strip examination. Prior toremoval of the FCA its interconnection to the Start Lever in thecockpit was checked and found to be correct.

After the fuel leak was seen during the Pre-departure Check on18 February 1996 the aircraft's fuel load was reduced and it wasremoved from service for rectification as a "casualty";no specific work schedule was raised for the rectification butall the actions taken were recorded in the aircraft's TechnicalLog.

The collector system within No 2 Main Fuel Tank terminates ina single pipe which emerges from the tank through the wing's frontspar into the top of the pylon. The engine Shut-off Valve

ispositioned in the pipe inside the tank and fuel in the pipe ispressurised by boost pumps in the tank. The pipe end is flangedinside the tank and a threaded fitting projects through the sparand is secured by a nut (with washer) which seats onto the frontface of the spar. The outboard end face of the threaded fittingis step grooved to take an O-ring in the inner groove and to acceptthe end of the next section of pipe in the outer groove to forma rigid coupling. When the outer knurled collar of the rigidcoupling is tightened (specified by hand) a small clearance existsbetween it and the nut securing the threaded fitting at the spar. On G-AWNB, immediately outboard of the rigid coupling there wasanother pipe connector, a flexible coupling. Access to thesefittings is made difficult by the close proximity of the engineair supply duct, control cables, electrical supply leads and otherwiring looms.

When the aircraft was received by the engineering team no leakwas visible. The initial fuel contents in No 2 tank of 30,000kg were increased by internal transfer until, at about 35,600kg, a leak again developed. It was found to be coming from aroundthe nut on the threaded fitting at the spar. Fuel was again transferredout of No 2 tank so that a repair could be begun. The rigid couplingwas undone to allow the nut on the threaded fitting to be backedoff. It was found that, though this nut was not loose, its untighteningtorque was low. The nut, washer and spar face were cleaned andre-assembled with a sealant. The rigid coupling was re-assembledwith a new O ring and wire locking was correctly appliedto the knurled retaining ring. As the sealant applied to thespar required some time to cure, a leak check was not carriedout at this time and the following Action was entered the TechnicalLog:

"Leak traced to front spare (sic) at eng feed (not pipe leaking),large lock nut backed off and sealant applied, nut repositionedand tightened, packing replaced..... Sealant applied04-45 hrs"

[Note: the "packing" referred to the O-ring in the rigidcoupling].

A new Defect entry was entered in the Technical Log to cover thedeferred leak check as follows:

"Check #2 pylon/front spar at eng fuel feed pipe for leaksafter sealant cured. (Will require 35,000 kg plus to leakcheck)"

In addition to the verbal handover briefing to the incoming teamwho would complete the work, an Airworthiness Hand-over Reportwas also written as follows:

"Fuel leak #2 pylon:- Fuel leaking from front spar at #2eng. feed pipe. Connection dismantled and area cleaned/dried. Sealant applied and connections re-assembled.

A/C on 11.00 E.T.S., leak check when sealant cured if satis. overwing& underwing panels to refit and seal"

The oncoming shift carried out the work and recorded the actionsin the Technical Log.

"Fuel redistributed #2 tank filled to 37,000 kg. No leaksevident from fuel feed pipe."

The process of filling the No 2 tank to more than 35,000 kg, raisingthe fuel level above that of the pipe at the front spar allowedthe sealing around the pipe to be checked for leaks but it didnot provide a check on the integrity of the seal in the rigidcoupling which had been disturbed. To check the seal the couplingwould have to be pressurised by the fuel pumps.

Inspection following the incident on 19 February 1996 discovereda leak at the rigid coupling. The rate of flow was not high. However, it is possible that, before push-back, some fuel mayhave gathered inside the wing (in front of the spar) and floodedout when the aircraft was moved giving the appearance of a largerleak than actually existed. From slight residues on the undersideof the wing it could be seen that fuel had been seeping from undersidepanels in front of the front spar. The O-ring seal removed fromthe rigid coupling was found to be intact, undamaged and of thecorrect part number. It is required to be lubricated at assemblybut whether it had been adequately coated with lubricant couldnot be determined. During the inspection an engineer noticeda further seepage of fuel around a joint at the bottom spar flangewhere sealant on the outside surface had become detached. Thetank was fully drained, purged and the sealing of the front sparrepaired from inside before the aircraft was returned to service.