Boeing 747-400, 9M-MPA

AAIB Bulletin No: 7/99 Ref: EW/C98/9/3 Category: 1.1

Aircraft Type and Registration:	Boeing 747-400, 9M-MPA
No & Type of Engines:	4 Pratt and Whitney PW4056 turbofan engines
Year of Manufacture:	1992
Date & Time (UTC):	27 September 1998 at 0752hrs
Location	Stand J8, London Heathrow airport
Type of Flight:	Public Transport (passenger)
Persons on Board:	Crew - N/A - Passengers - N/A
Injuries:	Crew - N/A - Passengers - N/A
Nature of Damage:	Overheat damage to aircraft skin and burnt insulation blanket
Commander's Licence:	N/K
Commander's Age:	N/K
Commander's Flying Experience:	
	Last 90 days - N/K
	Last 28 days - N/K
Information Source:	AAIB Field Investigation

The aircraft had arrived from Kuala Lumpur and was parked on Stand J8, whereupon the passengers disembarked. Baggage handlers opened the rear main freight bay door to unload the mixed load of baggage containers and freight on pallets. They found there was no power to the container handling system and called for an Engineer to investigate. Whilst waiting for him they manually unloaded some of the lighter pallets adjacent to the door. The Engineer's first action was to attempt to re-cycle the door since, in his opinion, the most common cause of complete loss of power to the handling system is usually that the door is not fully open or the 'door open' switch is not properly made to supply power to the cargo handling system. He found that there was no power to the door system either so he went to the circuit breaker panel in the Main Equipment Centre (MEC) and found the associated door circuit breaker tripped. He reset this and received a 'thumbs-up' from the loaders, indicating that handling system power was restored. As he walked away, he was suddenly alerted by shouts from the loaders and could see flames coming from under the cargo floor in the area of the inboard transverse container drive wheel. The fire was quickly extinguished with a powder extinguisher.

Description of the cargo handling system

In common with most wide-bodied aircraft, the Boeing 747 uses electrical power to load and manoeuvre cargo pallets in the freight bays. The operator uses a form of joystick control to selectively raise or lower retractable drive wheels which bear on the underside of the cargo and translate it laterally or longitudinally as required. The drive wheels form part of a Power Drive Unit (PDU), the other components being a linear actuator, mechanical linkage and supports (see Figure). The actuator provides the force to raise or lower the drive wheels whilst a separate electric motor

rotates the wheel. The PDU's which provide lateral movement of cargo into and out of the bay are situated at roughly fuselage STA 1875 as shown in the figure.

The cargo handling system is electrically isolated until the associated bay door is sensed to be in the fully open position. Circuit breakers (C/B's) which protect individual components of the system are located just inside the cargo doors. Provision is made for manual retraction of the drive wheels if required.

Examination of the aircraft

When first inspected by the AAIB the floor panels above the fire, in the area of the inboard lateral PDU, had been removed. It was apparent that the lateral translation wheel linear actuator had broken from its mounting bracket on the fuselage skin and was lying against a longeron. Still attached at the wheel end, it was resting on its electrical connector and it was clear that the wires had shorted against the structure, setting fire to the insulation blanket. The failure which allowed this to happen was of the light alloy link which connected the actuator to the bracket attached to the fuselage (see Figure). The rest of the mechanism seemed to be free to move with no signs of abnormal friction or jamming.

The lateral actuator C/B located just inside the aft cargo door was found to have tripped, as was the door opening C/B in the MEC.

It was noted that the fuselage bilges under the cargo floor were generally heavily littered with debris, such as paper cups and napkins, plastic bottles etc, but it was not possible to state whether this may have contributed to the fire. However, the particular bay in which the fire occurred appeared to have almost no litter.

The structure was examined by a metallurgist and pronounced fit for the return flight to Kuala Lumpur where permanent repairs were to be carried out. The overheated wiring loom was cut-back and taped as a temporary repair and the aircraft despatched with either the entire aft cargo loading system or just the lateral system disabled.

Subsequent information

Although the baggage loader did not initially mention the fact, it was subsequently found that he had discovered the lateral actuator C/B tripped after he had opened the door and he reset it. Unfortunately, he was not aware that the C/B had been deliberately tripped prior to departure from Kuala Lumpur as the broken PDU link had been discovered there. Although the aircraft's technical log had an entry to that effect, the airline did not have a policy of fitting collars to such C/B's or placarding them as inoperative.

Discussion

As found, the actuator was resting upside-down from its normal operating orientation and it was this which caused the electrical connector to rest on the structure. It is not known whether it had been placed in that position by maintenance staff or whether it had fallen thus after the link broke. The fracture of the link showed characteristics of tensile overload with no pre-existing defects. Such overload was a known problem (albeit resulting in deformation of the support brackets grounding the link to the fuselage structure) and Boeing produced a Service Bulletin (SB), No. 747-25-3128 rev.1 dated 7 August 1997 to advise operators of the problem and to introduce a

modification. The SB describes how a number of possible factors could conspire to enable the linkage to travel over-centre during manual retraction and, as the mechanism is then unintentionally locked, subsequent operation of the linear actuator causes failure of either the attachment brackets or the link, as occurred in this case. The modification provides for an additional link in the mechanism for actuators in the forward cargo compartment and for revised primary stops in both forward and aft compartments, the object being to prevent the over-centre condition from occurring. The reason why the additional link was not applicable to the rear compartment actuators is not known, but the aircraft was not modified and there was no regulatory requirement for it to be so. An additional possible factor was discovered when it was realised that the PDU assembly lacked two spacers which should have been fitted where the link was attached to the triangular support brackets on the aircraft structure.

The reason for the failure of the link is not known. Three possible causes have been cited:-

a) Excessive loads applied to the link, for example by an excessively heavy pallet or container.

b) The PDU experiencing the over-centre condition described above.

c) The missing spacers allowing eccentric loads to be applied to the link.

Ultimately though, it was the failure to ensure electrical isolation of a known unserviceable system which caused the fire. The reported sequence of events has not been completely explained in that the reason for the apparently associated tripping of the cargo bay door C/B remains unclear. There is little doubt however, that the incident would not have occurred had the loader realised that the lateral PDU C/B should not have been reset. It is understood that the airline concerned has reviewed its procedures for isolating systems which are known to be unserviceable.