Boeing 747-238B, G-VJFK

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Aircraft Type and Registration:	Boeing 747-238B, G-VJFK
No & Type of Engines:	4 Pratt & Whitney JT9D-7J turbofan engines
Year of Manufacture:	1974
Date & Time (UTC):	9 December 1996 at about 0015 hrs
Location:	Near JFK Airport, New York, USA
Type of Flight:	Scheduled Public Transport
Persons on Board:	Crew - 20 - Passengers - 342
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Loss of right hand 'off-wing' escape slide, minor damage to inboard flap upper surface and aft fuselage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	N/A
Commander's Flying Experience:	N/A
Information Source:	AAIB Field Investigation

Note - this incident is similar to that of B747-100, N204AE, at London Heathrow Airport on 24 August 1996. The account of that incident immediately precedes this in the AAIB Bulletin and the same set of illustrations and technical descriptions are used for reference.

History of flight

The aircraft left John F Kennedy Airport (JFK), New York, shortly after 1900 hrs local time. Departing from Runway 31L, the aircraft was at a height of 300 feet and an airspeed of 172 kt when the crew noted that the R WING ESCAPE DR caption had illuminated on the Flight Engineer's panel. This caption denotes unlatching of the compartment door for the right-hand 'off-wing' escape slide, which is operated, in an emergency, by a cable from the overwing Passenger Door 3. The crew report that they carried out the appropriate check list and continued the flight

with no noise or vibration noticed. The caption remained on throughout the flight and the aircraft made a normal landing at London Heathrow Airport.

At London the right hand off-wing escape slide was found to have deployed and separated from the aircraft, leaving the slide compartment door itself intact but open. A request was made to the authorities at JFK Airport to locate the missing escape slide but it was not recovered.

System description

The operation of the off-wing escape slide system in G-VJFK was identical to that in N204AE, described in detail in the preceding Bulletin account and accompanying Figures 1 to 4.

In brief, emergency operation from the overwing Passenger Door 3 mechanically unlatches a series of four 'claw type' latches (Figure 1) along the upper edge of the slide compartment door. The latch mechanism is connected to pyrotechnic deployment thrusters and operation of these thrusters rotates the door and slide pack outboard, actuating the inflation of the slide. The inflation was, in G-VJFK, by 'cool gas generator' and the gas flow induces ambient air to inflate the slide through injector pumps.

The Integrator mechanism (Figure 2) allows the compartment door to be latched and unlatched for maintenance. This Integrator is located just forward of the slide compartment and has a small access door. After maintenance or inspection, the latching of the compartment door is performed by operating the Integrator and the access door is then closed. The operating instructions for the Integrator are displayed on a placard on the inside of the access door (Figure 2).

On the Flight Engineer's instrument panel there is one illuminated caption for each of the off-wing slide compartment doors ("L *and* R WING ESCAPE DR"). Externally, there is also a physical 'latching indicator' (Figure 1), designed to provide verification of latching.

In some 747-100/200 fleets the off-wing slide system was removed when the overwing Passenger Door 3 was deleted and in the 747-400 the off-wing slide is incorporated into Door 3 itself. For maintenance organisations accustomed to servicing aircraft with 747-400 standard doors, as in this case, the off-wing slide system would only be seen during 'third party' maintenance work.

Recent maintenance

G-VJFK had recently (5 December 1996) received routine third party maintenance input, including work on the off-wing escape slide system. This work was primarily routine replacement of the pyrotechnic door thrusters (Figure 1) on both sides of the aircraft. None of the work disturbed the door locking mechanisms but some tasks did require the slide compartment door to be unlatched and then latched.

On 6 December 1996 the aircraft had flown one sector (London Heathrow to San Francisco), with the R WING ESCAPE DR illuminated from shortly after take off to 10,000 feet. This was reported by the operating crew as a technical defect and corrective action for this defect had taken place at San Francisco. The following three sectors were uneventful, with no recurrence, and no further work was performed on the off-wing escape slide system. The separation of the slide on 9 December 1996 took place, therefore, on the fifth sector following the maintenance input at London.

The nature of the corrective action at San Francisco was later established. The Maintenance Representative assigned to this operator had checked that the R WING ESCAPE DR caption was extinguished and had, from the ground, identified that the 'latch indicator' pin (Figure 1) and off-wing slide compartment door appeared flush with the fuselage.

Examination

Following the incident, G-VJFK was examined at London Heathrow. The right-hand off-wing slide pack and attachment hardware had separated from the aircraft but the compartment door had remained attached and was hanging open. The departing slide pack had caused some further damage to the inboard flap, at the wing trailing edge, and to the body fairing. Of the four 'claw type' door latches (figure 1), one was found partially open and the other three were found fully open.

It was evident that the slide's inflating bottle, the 'cool gas generator', had fired but the door thrusters, also pyrotechnic, had not. This was consistent with an inadvertent unlatching of the door mechanism but with no activation of the deployment cable from Door 3.

Examination of the relevant work sheets from 5 December 1996 showed that the manual latching of the off-wing slide doors had been performed by one engineer, followed by duplicate inspections by two additional engineers. In discussion it was evident that, because of the previous occurrence on G-VJFK, the engineers were cautious and did note that, within the Integrator mechanism, the

latching lever had to be operated several times before the locking pin appeared to engage fully (Figure 4a).

Further examination on G-VJFK and another 747 showed that, using the latching method specified on the placard on the inside of the service access door, deliberate movement of the locking shafts downstream of the Integrator mechanism could lift the locking pin out of its detent. Positive engagement of the locking pin required a deliberate additional step, rotating the 'unlatching' pawl counter-clockwise. This anomaly is described in detail in the preceding account (N204AE). It was also noted that it was possible for the R WING ESCAPE DR caption to be extinguished while the door latches were very close to their unlatched condition.

The engineering and operational evidence in this case is consistent with the manual latching of the G-VJFK's right-hand off-wing slide door on 5 December 1996 having been performed fully in accordance with the placard on the access door. However, as shown in Figures 3 to 7, it is possible for this technique to leave the locking pin only marginally engaged and for the locking shafts to back-drive the Integrator mechanism. This back-driving had been made more likely by the presence of excessive backlash in the operating cable upstream of the Integrator mechanism. Figure 9 shows the difficulty, if not impossibility, of identifying whether the locking pin is fully engaged.

Previous occurrences

This incident involved the same aircraft and door as an occurrence on 28 April 1996 at London Heathrow (EW/C96/4/10), reported in AAIB Bulletin 9/96. It was noted in that account that a number of previous instances of in-flight losses of off-wing slides had been reported and there were further instances of the compartment door being found unlatched after flight. The airframe manufacturer reported some 30 in-flight losses in the previous 20 years, generally following maintenance, and further reported the causes as improper closing or latching, incorrect indications of latching and improper rigging.

Service information

As part of the investigations into the inadvertent openings of the off-wing slide door in G-VJFK and N204AE, the Service information was examined. There had been at least 12 Service Bulletins from the manufacturer, over a period of some 18 years, but none appeared to deal directly with the mechanical design or operation of the Integrator unit itself.