Boeing 767-31K, G-DIMB

AAIB Bulletin No: 6/99 Ref: EW/C98/11/04/025 Category: 1.1

Aircraft Type and Registration:	Boeing 767-31K, G-DIMB
No & Type of Engines:	2 CF6-80C2 turbofan engines
Year of Manufacture:	1997
Date & Time (UTC):	25 November 1998 at 0635 hrs
Location:	Manchester International Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 11 - Passengers - 318
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Major damage to cabin floor beam; minor damage to E6 compartment panelling; damage to the standby system power cable and associated electrical arcing
Commander's Licence:	Not relevant
Commander's Age:	Not relevant
Commander's Flying Experience:	Not relevant
Information Source:	AAIB Field Investigation

History of the flight

Before departing Las Vegas, the rear hold had been loaded with eleven LD2 size baggage containers distributed in two rows of five on each side of the hold space forward of the baggage door, and one container on the left side, aft of the door. The roller mat in the door area, and the right rear container position, were empty.

Upon arrival at Manchester, baggage handling staff found that at least two of the containers had moved in flight and had jammed in the rear section of the hold and door area. One of these had penetrated the ceiling of the hold and damaged the cabin floor structure above. The lateral guide stops at the forward edge of the doorway, which act as stops to prevent rearward movement of the containers in flight, were found retracted and manually latched down. In contrast, the lateral guide stops at the rear edge of the doorway, which prevent forward movement of any containers positioned aft of the door, were found extended. The centre guide plates between the two rear pairs of containers were found retracted.

Cabin crew seated in the rear cabin had heard a 'thump' during the take off at Las Vegas, but they had attributed the noise to a compartment door in one of the toilets swinging open and consequently did not report it. Some passengers also reported hearing a noise, but were told that it was due to turbulence.

AAIB investigation

Configuration of the container guide stops

The incident was reported to the CAA initially, via the Mandatory Occurrence Reporting (MOR) system, and not directly to the AAIB. Consequently, the containers had been unloaded and the various motorised guide stop mechanisms had been operated several times before there was any opportunity for AAIB examination of the hardware. As a result of this, the precise 'as found' positions of the containers and the settings of the various stops and guides could not be established with certainty. However, the baggage handling crew leader confirmed that the lateral guide stops had been found manually latched into the retracted position, and photographs taken by a supervisor immediately after the first of the displaced containers had been removed, and before any stops had been disturbed, confirmed this account. (The lateral guide stops normally extend and retract automatically during loading operations, as required).

Damage

The ceiling liner adjoining the rear edge of the doorway was punctured on the right side of the aircraft and a 1.5 metre length of the cabin floor support beam above this area, at station 1351, was badly buckled and fractured (see Figure 1). The damage was consistent with a rearward impact made by the top of a baggage container, and this was confirmed by matching damage found on one of the containers from the aircraft. The insulation of the cable (part of the standby power system) which runs transversely along the back face of the broken floor beam near its lower edge, was also damaged and there were signs of electrical arcing between the conductor and the torn web of the beam, as shown in Figures 2a and 2b. Further damage was found on secondary structure and panelling enclosing the E6 aft equipment centre, located on the right side of the fuselage behind the baggage door (Figure 1). However, the auxiliary power unit (APU) battery, the APU controllers, and various relays and associated wiring within this compartment were undamaged.

Several of the motorised guide stops in doorway roller mat were broken in a rearward direction, evidently as a result of projecting parts being forcibly struck by the bottom edges of sliding containers.

Investigation into loading operations at Las Vegas

On behalf of the AAIB, the National Transportation Safety Board (NTSB) initiated an inquiry at Las Vegas to examine the circumstances under which the baggage containers had been loaded. It was subsequently reported that the loaders had experienced trouble unloading the containers following the

aircraft's arrival on the outbound flight to Las Vegas, and that the guide locks were manually 'safety locked' into the retracted position to facilitate offloading. Subsequently, and before loading operations

for the return flight to Manchester had been completed, there was a shift change and the outgoing shift failed to advise the incoming shift that the guide locks had been manually fixed into the retracted position. The incoming shift also failed to check the condition of the guide stops upon completion of loading operations, prior to closing the baggage door, and consequently the failure of the guide stops to extend automatically was not noticed; the aircraft subsequently took off with the stops still retracted.

The NTSB reported that once these circumstances had become known, the loading company's general manager had immediately instituted re-training of the loading crews and has also written new procedures for the load master, to prevent a recurrence.

Discussion

When filled with bags, each LD2 sized container may be expected to weigh 700 kg or more, and it follows that the total weight of each row of five containers in the forward part of the hold would have been at least 3.5 tonnes. Once loaded, the containers rest on free-spinning rollers set into load tracks fixed to the floor of the hold and are restrained from moving rearward by the lateral guide stops. The failure to extend these stops therefore would have allowed both columns of containers to roll back unimpeded onto the doorway roller mat as soon as the aircraft rotated to positive incidence on take-off. There are no doorway guide stops on the left side of the roller mat, and evidently the column of containers on the left side continued to roll back, unimpeded, until they hit the rear set of (extended) lateral guide stops, which brought them to rest without causing any significant damage. The containers on the right side, however, hit projecting parts of the doorway guide stops as they passed over the roller mat. These impacts fractured and bent the stop mechanisms, and as the containers rode over the broken-down remains their leading edges were lifted up slightly so that they 'jumped' the lateral guide stops at the rear of the doorway area. One of the containers had also lifted sufficiently to drive its top edge into the flexible ceiling liner panel and impact the lower chord of the floor beam at station 1351.

The damage to the floor beam did not seriously hazard the aircraft structurally, but the electrical arcing against the standby power system cable was potentially dangerous. Whilst the absence of doorway guide stops on the left side of the roller mat makes it less likely that containers will ramp upward and impact the cabin floor structure as they traverse the left side of the doorway area, there nevertheless remains a possibility of similar damage occurring on the left side of the floor beam at station 1351, where the APU fuel line and the standby power system cable cross in close proximity to one another (see Figure 3).

Impact damage to the standby power system cable and consequent electrical arcing onto the APU fuel line in this area would almost certainly result in a serious, potentially catastrophic, fuel fire in the rear fuselage. The risk of impact damage to the standby power system cable and APU fuel supply line could be reduced by improving the impact protection of this area and re-positioning the cable higher on the floor beam, where it would be less likely to be damaged by container aft displacement.

Safety recommendations

As a result of these findings from this incident investigation and particularly in view of the serious fire risks which appear possible from unrestrained container impact damage to the floor beam area at station 1351 on the left side of the rear hold on Boeing 767 aircraft, the following Safety Recommendations are made:

Recommendation 99-6

The FAA and the aircraft manufacturer should consider local modifications to the standby system power cable and adjacent fuel supply line at the station 1351 floor beam on the left side of the rear hold on Boeing 767 aircraft to reduce the potential risk of impact damage, from contact with unrestrained containers, to the standby system power cable and consequent potential arcing penetration of the adjacent fuel line.

Recommendation 99-7

In order to reduce the risks of unrestrained baggage container aft displacement in the rear hold of Boeing 767 aircraft due to incorrectly set lateral stops, the FAA and the aircraft manufacturer should consider the provision of an associated warning system to alert flight crew and baggage handling personnel and/or the interlocking of the retractable stop and baggage door closure systems to inhibit door closure in the event of incorrectly set stops.