Boeing 737-300, G-LGTI

AAIB Bulletin No: 6/2004	Ref: EW/C2003/07/07	Category: 1.1
INCIDENT		
Aircraft Type and Registration:	Boeing 737-300, G-LGTI	
No & Type of Engines:	2 CFM56-3B2 turbofan engines	
Year of Manufacture:	1988	
Date & Time (UTC):	30 July 2003 at 0500 hrs	
Location:	Newcastle Airport, Tyne and Wear	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Fire damage to electrical wiring and insulation material	
Commander's Licence:	Airline Transport Pilot's Licence	
Information Source:	AAIB Field Investigation	

Synopsis

During the pre-flight preparation the crew noticed that both of the ground service circuit breakers were out, attempts to reset these were unsuccessful. The commander became aware of an electrical burning smell and smoke and asked the engineer to shut the aircraft down, ordered an evacuation and requested that the fire service be called. A short duration flash fire had apparently occurred below the cockpit floor on the right side, forward of the Electrical and Electronics compartment. Examination of the galley power feeder cables in the area showed evidence of some pre-existing damage consistent with the insulation material having being torn away from the wires. The galley feeder cables carry a three phase 115V providing the possibility for arcing, and this could eventually have started the arc tracking of polyimide insulated wires. It is probable that the damage to the galley feeder cables occurred at an earlier time, possibly during the replacement of the forward toilet service panel in November 2002. It could not be determined why arcing occurred on this particular occasion.

History of flight

The flight crew boarded the aircraft to prepare it for a scheduled morning flight to London Gatwick Airport. At the time the Auxiliary Power Unit (APU) was running, although the external ground power was plugged in and powering the electrical systems. During the pre-flight preparation of the flight deck the crew noticed that both of the ground service circuit breakers were out. There was a company engineer on board so, in the presence of the crew, he attempted to reset the circuit breakers. The two breakers would not reset and during the attempt the ground power tripped off and two further circuit breakers popped. APU electrical power was then selected onto the aircraft and a further unsuccessful attempt to reset the breakers was made.

At this stage the flight crew left the engineer to continue to rectify the problem and waited in the aircraft cabin. The commander then went into the terminal area for a short time to advise the passengers of the reason for the delay. On his return he was informed by the engineer that during the fault finding process further circuit breakers had popped. He waited in the forward part of the cabin and after a while became aware of an electrical burning smell. He returned to the flight deck to discover increasing amounts of smoke, whereupon he asked the engineer to shut the aircraft down and ordered all persons on board to evacuate.

When outside the aircraft smoke could be seen coming from both the forward electronic bay and airstairs hatches. The commander went up into the terminal to find the nearest telephone. He spoke to the call centre operator and requested that the fire service be called, but also that only one vehicle should attend so as not to alarm the waiting passengers. The operator repeated back his instructions to confirm they were correct and then called the Tyne and Wear Metropolitan Fire Brigade in accordance with her written procedures. Although it was not required by the procedures she then called Air Traffic Control (ATC) to advise them of the incident. ATC then contacted the Airport Fire Service (AFS) and a ground incident was declared. The AFS deployed in response and arrived at the aircraft ten minutes after the original call by the commander to the call centre. They used a thermal imaging camera in the flight deck and around the aircraft to check for heat sources. The camera detected a heat source indicating 800ºC near the forward electronics bay.

Airport procedures

The written procedures for the call centre operators in the event of being notified of a fire incident included the following: 'to inform Tyne and Wear Metropolitan Fire Brigade'. There was not any instruction to notify the Airport Fire Service (AFS) or ATC.

The normal policy of the AFS is to deploy their whole fleet of fire vehicles when notified of any incident and to subsequently downgrade the attendance if required.

Aircraft Examination

The circuit breakers which had tripped initially were the three 28V AC Ground Service A, B and C phases (Circuit Breakers D13, D14 and D15) and the 28V AC Transfer Bus #1 (E15). After the resetting attempt the two further circuit breakers that tripped were the 28V AC Transfer Bus #2 (F15) and the Alternate Trailing Edge Flap Drive (D10).

Some fire damage was observed inside the fuselage on the right side of the aircraft, in the area of the forward toilet service panel, beneath the cockpit floor and forward of the Electrical and Electronic compartment (see Figure 1). The area contains the toilet servicing ducts as well as inertial reference units and numerous wiring bundles. Included in the list of systems affected by the damage were; autothrottle system, digital stall warning system, engine idle control, engine ignition, thrust reverser control (No 2 Engine), right wing slat and flap indicating systems, altitude information from Air Data System No 2, Inertial Reference Systems, EFIS power and weather radar.

Figure 1: Fire damage to wiring and insulation material viewed from nose landing gear bay

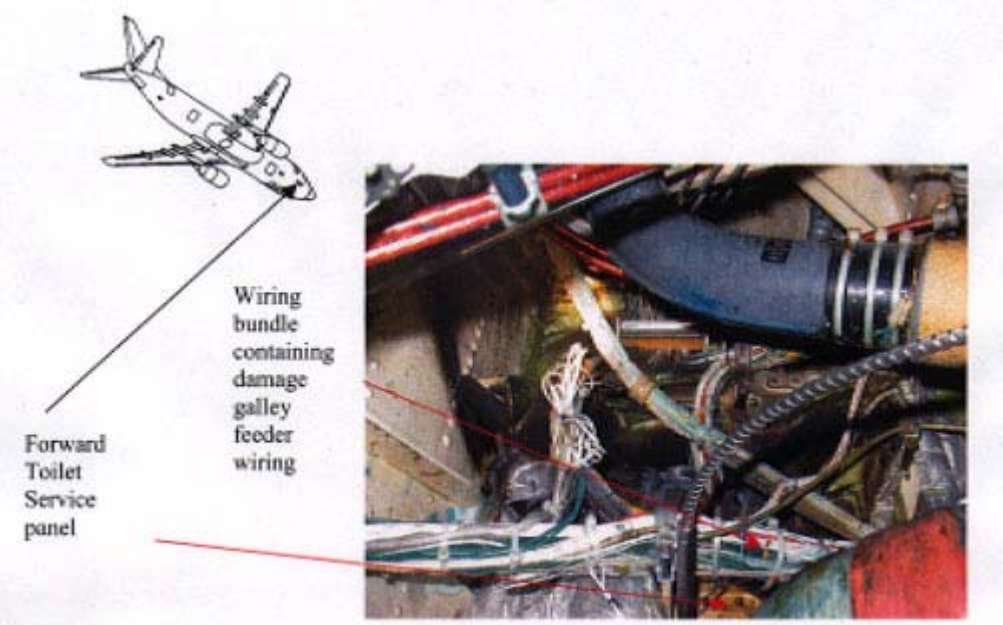

Figure 1 – Fire damage to wiring and insulation material viewed from nose landing gear bay

There was evidence of dried blue fluid (toilet sanitising fluid) contamination indicating that there had been leakage from the toilet charge pipe in the area of the forward toilet service panel. The ground engineer also reported that the area has been wet from the ingress of moisture from rainfall the previous night when the integral airstairs had been used. The APU had been run for a period of 20 minutes in order to dry the underfloor area before resetting the Circuit Breakers.

A short duration flash fire had apparently occurred; there was evidence of fire having consumed some of the aircraft insulation material. The majority of the wiring bundles from this area were insulated with polyimide (Kapton). Some of these wires had separated and examination showed evidence of damage from heat and arcing but there was no evidence that the wires had been contaminated or chafed prior to the fire. Similarly, there was no evidence on the adjacent structure that chafing or arcing had occurred. However, examination of the 10 gauge Boeing Material Specification (BMS) 13-31 3-Phase 115V AC galley power feeder cables did show evidence of some pre-existing damage (see Figure 2). The insulation material for these cables is a mineral filled polytetrafluoroethylene (ie Teflon).

Figure 2: Damage to galley power feeder cables

Photograph courtesy of Boeing Commercial Airplanes

Figure 2 - Damage to galley power feeder cables

Laboratory analysis of wiring segments removed from the aircraft was carried out by the aircraft manufacturer. They concluded that there was evidence that some insulation material from the galley feeder cables had been missing prior to the incident; the exposed edges of the insulation contained 'grooves' along its length and some of the wire strands appeared mechanically damaged. Tests on undamaged wires showed that damage similar to the 'grooves' could be caused by the insulation being torn away rather than cut from the wire.

Maintenance history

The operator had taken over the lease for this aircraft in March 2001. In November 2000 maintenance work had been carried out to replace the forward toilet service panel by a third party maintenance organisation behalf of the previous operator. The upper latch of the servicing panel door was replaced on 9 March 2003. No maintenance work had been carried out in the area above the forward toilet service panel highlighted by this incident by the current operator and none prior to this flight. There were no reports of any previous electrical problems on this aircraft.

Analysis

The galley feeder cables carry a three phase 115V AC giving a 200V potential between the exposed wires of the damaged cables, thus providing the possibility for arcing. It is probable that the arcing between the galley feeder cables eventually started a process of arc tracking of the polyimide insulated wires, which would have continued until the circuit breakers tripped and started again when the electrical power was reapplied. It could not be determined when the damage to the galley power feeder cables occurred or why arcing sufficient to cause the fire occurred on this particular occasion.

Damage consistent with the insulation material being torn away from the wires was identified on at least two of the wires. It is probable that this damage occurred at some earlier time, possibly during

the replacement of the forward toilet service panel in November 2002. The ignition source of many previous occurrences of on-board fires has been attributed to mechanical damage to wiring as a result of aircraft maintenance.

The AFS airside location means they are the most immediate source of fire cover airside for the airport. The local service is off airport, takes longer to deploy to the airport and has less direct airside access, but is able to provide extra manpower and equipment if required. It is therefore inappropriate that instructions to telephone operators, or other personnel, should require a local fire service alone to be contacted for an airside fire alert. The action of the call centre operator in contacting ATC ensured that there was an AFS deployment even though the callout was delayed by ten minutes as a result of the procedures.

Safety action

The operator has since carried out visual inspections of the wiring in the area above the forward toilet service panel highlighted by this incident on a sample of six other B737 aircraft. No wire damage or interference between wire bundles and aircraft structure was found.

Since this incident the procedures in the Emergency Orders for Newcastle Airport have been revised to include an instruction to call centre operators to notify the AFS directly as well as Tyne and Wear Metropolitan Fire Brigade in the event of a fire alarm or incident. As a result no specific safety recommendations have been made by the AAIB. This incident has highlighted airworthiness issues which reflect broader concerns on all aircraft types regarding wiring condition, particularly as aircraft age and modifications are introduced. These broader concerns are addressed in the overview document included in this issue of the AAIB Bulletin.