No: 9/89 **Ref: EW/C1111** **Category: 1a**

Aircraft Type and Registration:	McDonnell Douglas Corp DC 10-30, G-BHDJ
No & Type of Engines:	Three General Electric CF6-50 turbofan engines
Year of Manufacture:	1980
Date and Time (UTC):	7 June 1989 at 1229 hrs
Location:	London Gatwick Airport
Type of Flight:	Scheduled passenger
Persons on Board:	Crew - 14 Passengers - 168
Injuries:	Crew - None Passengers - 4 (minor)
Nature of Damage:	Ruptured HP bleed manifold, associated damage to an oil vent pipe and combustion chamber casing, minor damage to engine cowling.
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	40 years
Commander's Total Flying Experience:	9504 hours (of which 134 were on type)
Information Source:	AAIB Field Investigation

History of the flight

The aircraft, using the call sign BA 225, was to carry out a flight from Gatwick to Houston, USA, with 168 passengers and was scheduled to depart at 1115 hrs. The departure was delayed by a minor problem with No 1 engine thrust reverser and the aircraft left the stand at 1205 hrs.

The weather report gave the wind as 345°/15 kt and runway 08R was in use. The take-off weight of the aircraft was 255,807 kg, which gave a V_1 speed of 160 kt. The flight was cleared for take-off at 1228 hrs. The commander was the handling pilot and the take-off run was normal until, at a speed of around 140 kt, the co-pilot and the flight engineer saw that the N_1 gauge for No 3 engine indicated about 7% too low and that the No 3 EGT was showing an abnormally high temperature of about 945°C. Within about one second, the ENGINE FAIL light illuminated and, momentarily (one second), the fire warning lights showed and the fire bell rang.

The speed had risen to 147 kt and the commander immediately ordered "Stop - Reverse". The

emergency stop procedure was effected and the co-pilot informed ATC, who put the emergency services on 'Local Standby' at 1229 hrs. During the deceleration, it was noted that the brake temperatures were rising and had reached about 350°C. When the aircraft had slowed to a low forward speed, the fire drills were carried out on No 3 engine and the commander, calling for the emergency services, elected to turn off the runway into holding point 'B' before stopping the aircraft.

The aircraft came to rest at holding point 'B' at 1229.5 hrs and the Airport Fire Service (AFS) reported being in position at the aircraft at 1231 hrs. Although their reponse had been timely, the arrival of one vehicle was delayed slightly as it had been told that the subject aircraft was a Tristar, one of which type was positioned at the other end of the runway. However, seeing the DC 10 with smoking brakes at holding point 'B' the fire crew quickly diverted there. The commander had been considering the possibility of taxying back to the stand but, when the AFS reported to him that, although there was no sign of fire in No 3 engine, the brakes were smoking (this is not an unusual event following an emergency stop), he decided to shut down the engines and request a tractor to tow the aircraft back to the stand. The commander also gave a public address to the passengers and cabin staff, informing them that there was a small technical problem and that he would keep them informed. However, a few minutes later a brake fire suddenly erupted in the aircraft centre and right landing gears. The senior fire officer, seeing that the fire in the right gear had been immediately extinguished, considered that the main dangers lay in the centre and left landing gears. This, together with the wind direction and the position of his vehicles, caused him to recommend to the commander an immediate evacuation from the "starboard" exits only. This is believed to have occurred at 1237 hrs. Also at this time, the senior fire officer upgraded the incident from a 'Local Standby' to an 'Aircraft Ground Incident'. The fire in the centre gear took 3 or 4 sustained applications of extinguishant (BCF) before it was put out.

On receiving the fire officer's recommendation, the aircraft commander immediately gave a public address ordering an emergency evacuation from the right side exits of the aircraft.

Once again, the operational aspects of the investigation were severely hampered by the absence of CVR evidence, because electrical power was re-applied to the aircraft following the evacuation. It was further hampered by the fact that the 'AFS to Aircraft' frequency 121.6 MHz (VHF) was not recorded.

Rescue and survival

On receipt of the evacuation order from the commander, the cabin crew immediately carried out their drills, deploying the emergency slides from exits '1 Right', '2 Right' and '4 Right'. However, the stewardess at exit '3 Right' saw smoke outside and so she together with the stewardess at exit '3 Left,' decided, as was their prerogative, to use that exit instead.

Some difficulties were encountered during the evacuation. Many passengers, despite having seen the 'on board' safety video and hopefully read the safety card in the seat pockets, took their hand baggage to the exits. Consequently, access to some of the exits was restricted by increasing piles of baggage taken from the passengers by the cabin crew. Also, as a result of a cabin attendant not removing her high heeled shoes, the 'No 1 Right' slide was punctured and partially deflated and the 'No 3 Left' overwing walkway split into a large 'L' shaped tear at the point where it joined the slide. Finally, because the cabin crew received the evacuation message and signal at the same time as the passengers, some found themselves being jostled whilst opening the door and whilst reaching down and outwards to operate the manual slide release, which is a Company requirement regardless of the operation of the automatic inflation system. Nevertheless, the evacuation was carried out in less than 90 seconds and only four passengers sustained minor injuries.

When the crew had checked that there were no passengers remaining on board, they themselves evacuated and assisted the emergency service personnel in grouping the passengers at a safe distance from the aircraft. The passengers and crew were then transported to the terminal and the incident was 'closed' at 1425 hrs.

Engineering Investigation

Engine

Examination of the No 3 engine revealed that there had been no engine fire, but that the 14th stage bleed duct had ruptured where it passed under the engine. The resultant leakage of hot air had been detected by an adjacent fire-wire and had triggered the engine fire warning despite the correct operation of the blow-out panel, on the underside of the cowling, which allowed the hot gases to escape.

At the time of the incident the engine had achieved 33371 hrs/8681 cycles and the last shop visit was in September 1985. The engine is condition monitored, ie there are no hard time removals except for certain life limited parts. It is thus difficult to track the non-lifed components such as the HP bleed duct.

Following the incident it was found there was (non related) FOD damage to a 14th stage compressor blade: this was the reason for removing the engine. The bleed duct had failed in a spiral mode (see attached Figure), with the flailing portion striking the "B" sump vent pipe, causing the latter to be pushed rearwards into the combustion chamber casing.

The 14th stage (HP) bleed duct is supported on a number of struts attached to the engine casing. Each strut picks up on a lug which is welded to a saddle which is in turn welded to the duct. The failure was

the result of a fatigue crack originating from the edge of a weld attaching a saddle to the duct. The crack appeared to be due to an abrupt transition between the weld filler and the surface of the duct. It was noted that the quality of the welding was somewhat variable and that there had been no attempt to blend the toe of the weld (which would have conferred a higher fatigue resistance).

According to the engine manufacturer there have been 84 reported failures of this duct across the fleet, 16 of them since January 1989. Included in the overall total are 17 inflight shutdowns and 9 rejected take-offs.
The operator carried out a special check on the fleet following the incident, and two other ducts were found to be cracked. In addition all ducts will in future be inspected using florescent dye penetrant at every engine shop visit. Previously, all checks on this component were visual.

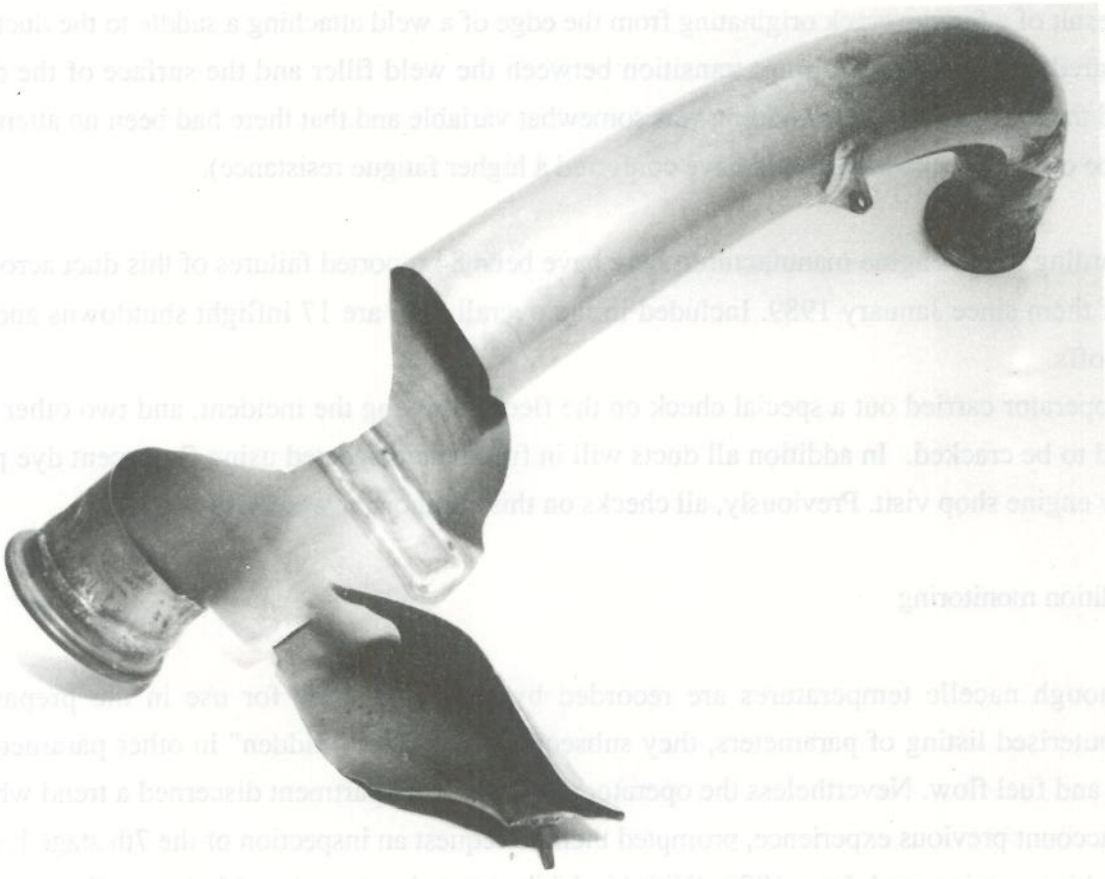
Condition monitoring

Although nacelle temperatures are recorded by the flight crew for use in the preparation of a computerised listing of parameters, they subsequently become "hidden" in other parameters such as EGT and fuel flow. Nevertheless the operator's propulsion department discerned a trend which, taking into account previous experience, prompted them to request an inspection of the 7th stage bleed duct on the subject engine on 1 June 1989. With hindsight it can be seen that this instruction was rather too specific as the 14th stage was not inspected.

Since the incident the flight crews have been required to record the nacelle temperatures in the climb as well as the cruise, and these are now picked out separately in the computer listings. Also, the operator has asked the aircraft manufacturer to provide alert values for nacelle temperatures in the cruise.

Overwing emergency slide

Although this functioned correctly, it was subsequently noticed that a rubber hose connecting the left side bolster to the header tube had broken at the point where it entered the header tube. The latter remains uninflated so long as it is attached to the wing: however when the slide is used as a raft, a toggle is pulled which releases a clamp on the hose, thereby allowing air from the side bolster to inflate the (much smaller capacity) header tube. As the break in the hose was downstream of the clamp there was no air loss on this occasion. However, had the slide been used as a raft, the side bolster would have become deflated. A cause for the broken hose was not established although it was considered possible that it may have been grabbed by a passenger during the evacuation.



G-BHDJ failed 14th stage bleed manifold