Lockheed Tristar, C-FTNG

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Aircraft Type and Registration:	Lockheed Tristar, C-FTNG
No & Type of Engines:	3 RB-211-22B turbofan engines
Year of Manufacture:	1973
Date & Time (UTC):	20 October 1997 at 1335 hrs
Location:	Runway 08R at London Gatwick Airport
Type of Flight:	Public Transport
Persons on Board:	Crew - 13 - Passengers - 357
Injuries:	Crew - Nil - Passengers - 11 minor
Nature of Damage:	Damage to pneumatic duct and adjacent hydraulic pipes
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	17,000 hours (of which 7,175 hours were on type) Last 90 days - 235 hours Last 28 days - 70 hours
Information Source:	AAIB Field Investigation

History of the flight

The aircraft arrived at London Gatwick from Athens with 322 passengers. During this flight, there had been no unserviceabilities and the inbound commander reported this to the commander of the new crew who would be operating C-FTNG onwards to Toronto. The new commander also confirmed from the Technical Log that there were no carried forward defects and completed a satisfactory external inspection of the aircraft. The passengers from Athens were continuing on to Toronto with an additional 35 passengers who boarded the aircraft at Gatwick.

Engine starts were normal and C-FTNG was fully serviceable while taxiing to Runway 08R. The weather was good with a surface wind of 075°/16 kt, varying between 030° and 110°, maximum 27 kt and minimum 10 kt. With his clearance to line up and take off, the commander as handling pilot, taxied on to Runway 08R and advanced the thrust levers. The Auxiliary Power Unit (APU) was 'Off', the engine bleed switches were 'Open' and the air conditioning packs were 'Off'. As the engine power was increasing and the aircraft accelerating, warning lights illuminated on the Caution and Warning Annunciator Panel (CAWP); in addition to these two lights of 'Hydraulic System' and 'Flight Control Panels', he also noted a 'Rudder Hydraulic Limiter Push' light illuminate on the overhead panel. Coincident with this, there were also indications of system malfunctions on the flight engineer's panel. These included 'J ' 'Area Overheat' light, hydraulic system 'A' pump output 'Lo Pr' light and a quantity decrease on the hydraulic system 'A' quantity gauge. As the commander retarded the thrust levers, the 'Area/ Duct Overheat' light illuminated on the CAWP. At about the same time, Gatwick ATC transmitted to the aircraft: "*'CALLSIGN'* ABORT YOUR TAKE-OFF ABORT YOUR TAKE-OFF YOU'VE GOT SMOKE FROM ONE OF YOUR ENGINES ABORT YOUR TAKE-OFF". The flight crew acknowledged this instruction and then asked ATC where the smoke was coming from. When the controller advised them that it appeared to be from the "CENTRAL ENGINE BY THE LOOKS OF IT NUMBER TWO", the commander closed down Number two engine; while this R/T exchange was going on, the flight crew checked all engine instruments and detected no abnormalities.

With C-FTNG continuing at slow speed down the runway, the commander was aware of the location of the 'Fast Taxy Exit' and could already see fire vehicles in that area; this exit is 1,895 metres along the runway and is close to the fire station. Coincident with his call to the aircraft, the ATC controller had activated the crash alarm and the AFS were positioned at the north of the 'Fast Exit' before C-FTNG had cleared the runway. The Aft Fuselage 'Isoln Valve' was selected off, to stop bleed air entering area 'J' in the aft fuselage and as the aircraft taxied off the runway, the flight engineer started the 'B' system electric pump to provide main brake pressure; this system is normally powered by engine Number two. On the 'Fast Exit', the commander stopped the aircraft just short of the AFS vehicles on a heading of 055°(M) and asked ATC if the smoke was still there; meanwhile, the flight engineer had selected numbers two and three 'Packs' on and also noted a decrease in both quantity and pressure on the 'B' hydraulic system. The controller confirmed that the smoke was still present and asked the crew to call the AFS on frequency 121.6 MHz. Radio contact was quickly established between the flight crew and the fire officer.

On initial contact, the fire officer requested that the commander close down his Number three (right) engine to enable the AFS personnel to carry out a visual inspection of the rear underside of the fuselage. Then, while this inspection was taking place, the commander confirmed to the fire officer that Numbers two and three engines were closed down, that the APU was not running and that two hydraulic systems on the aircraft were inoperative. The inspection revealed that there was no sign of fire but that smoke was coming from the leading edge of the tailplane and from a grill at the bottom of the fuselage; additionally, the right of the rear area of the aircraft was covered with a liquid. As this information was being passed to the commander, the flight service director (FSD) entered the cockpit to advise the commander that 'light smoke' was entering the rear of the passenger cabin. When this later information was relayed to the AFS, the fire officer recommended that the commander should initiate a controlled evacuation from the front slides. The commander accepted this recommendation, briefed his FSD and flight crew and then initiated the evacuation.

With the commander and first officer remaining in the cockpit and in radio contact with the fire officer, the two front slides on each side of the fuselage were deployed and AFS personnel stationed at the bottom of each one; the evacuation took approximately 10 minutes to complete and the passengers were quickly transported to the terminal area.

After the evacuation, the slides were removed from the aircraft , the aircraft was checked by engineers from another company and then towed clear of the runway. The runway was re-opened at 1509 hrs, 34 minutes after the initiation of the incident.

Eleven passengers subsequently were taken to hospital; one had a fractured collar bone and the others had chest and back pains. Four of these latter patients were retained overnight.

Flight Data Recorder

Both flight recorders were removed from the aircraft and replayed at AAIB. The voice recorder, which was of 30 minutes recording duration, had continued to run and hence had overwritten the period of the incident.

The data recorder confirmed the sequence of events as recalled by the crew and showed that the maximum speed achieved by the aircraft during the aborted take-off roll was 68 kt.

Engineering investigation

Examination showed that an elbow section of a large bore titanium duct, delivering air from No 2 engine bleed system, had blown out. This had caused secondary damage to adjacent hydraulic pipes in 'A' and 'B' systems which accounted for the observed hydraulic system failures.

Pictures of the failed section of the duct, part number 1519938-109, were sent to the aircraft manufacturer who considered that the fracture was not caused by hydrogen embrittlement, as were other duct failures that they had seen. The failed duct was therefore sent to the aircraft manufacturer to determine whether a new failure mode existed. Further examination showed that the failure had been caused by a massive over pressurisation of the air duct.

The operator, who had repaired the aircraft and recovered it to Canada, discovered that the No 3 engine isolation valve was faulty; the isolation valves from all three engines were replaced and sent to the valve manufacturer for testing. Further work by the operator indicated that pressure spikes in the pneumatic system could have been caused by the HP Valve controller rather that the engine isolation valves. The duct failure was on an aircraft which had a low modification standard of controller which did not incorporate a 1975 Hamilton Standard Service Bulletin (SB) that had been raised specifically to address pressure spikes.

As a result of these findings the operator has taken the following actions:

Revision of the bleed air system inspection procedures and frequencies. A systematic visual inspection on all ducts is now performed at every 'C' check (3,500 hour intervals).

A fleet campaign to overhaul engine isolation valves by Hamilton Standard, the valve manufacturer.

A revision to take-off procedures to have one or two Environmental Control System (ECS) packs selected on to reduce the likelihood of pressure spikes.

The operator was made aware by Hamilton Standard that SB 36-1047 exists to reduce the response time of the HP valve controller in order to provide more time for the isolation valves to regulate duct pressure and minimise pressure spikes in the system. A review of currently installed HP valve controllers in the operator's fleet revealed that three aircraft were equipped with pre-36-1047 controllers and that these aircraft had experienced duct failures. Controllers are being modified to the latest standard.

Subsequent action

The aircraft manufacturer concluded that the operator found nothing that would prove, beyond a reasonable doubt, that the duct failures can be attributed to a single element. However, the current course of action will greatly improve bleed air system performance and therefore radically reduce the probability of future duct failures.

The operator has sent seven engine isolation valves to Hamilton Standard for evaluation. Hamilton Standard has advised that two valves passed bench tests, and five valves failed response time and limit switch tests. One valve was found with the flapper ring broken, which would prevent the valve butterfly from completely closing. This problem could cause bleed air leakage within the system, which could be a problem if all ECS packs were selected off. The valve with the broken flapper ring was installed on C-FTNG at the time of this accident.