SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 757-258, G-STRZ
No & Type of Engines:	2 Rolls-Royce RB211-535E4 turbofan engines
Year of Manufacture:	1997
Date & Time (UTC):	28 January 2009 at 2335 hrs
Location:	Following departure from Accra, Ghana
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 9 Passengers - 96
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	12, 000 hours (of which 3,500 were on type) Last 90 days - 45 hours Last 28 days - 30 hours
Information Source:	AAIB inquiries, company investigation reports and FDR data

Synopsis

The aircraft had a blocked pitot tube, causing an airspeed discrepancy, which was detected early during the takeoff roll. The commander decided to continue the takeoff and deal with the problem whilst airborne. After passing FL180 the crew selected the left Air Data switch to ALTN, believing this isolated the left Air Data Computer (ADC) from the Autopilot & Flight Director System (AFDS). Passing FL316, the VNAV mode became active and the Flight Management Computers (FMCs), which use the left ADC as their input of aircraft speed, sensed an overspeed condition and provided a pitch-up command to slow the aircraft. The co-pilot was concerned about the aircraft's behaviour and, after several verbal prompts to the commander, pushed the control column forward. The commander, uncertain as to what was failing, believed that a stick-pusher had activated. He disengaged the automatics and lowered the aircraft's nose, then handed over control to the co-pilot. A MAYDAY was declared and the aircraft returned to Accra. The operator's subsequent engineering investigation discovered the remains of a beetle-like creature in the left pitot system.

History of the flight

The aircraft commenced its takeoff roll from Accra, Ghana at 2334 hrs with the commander as PF. Before the '80 kt' call was made, the commander noticed that his ASI was not functioning. He elected to continue the takeoff using the co-pilot's and standby ASIs, which appeared to be functioning normally, as he believed the weather conditions were suited to resolving the problem when airborne. The Engine Indication and Crew Alerting System (EICAS) messages, AIRSPEED UNRELIABLE, MACH/SPEED TRIM and RUDDER RATIO illuminated during the initial climb below 400 ft. The commander handed over control to the co-pilot who, at 1000 ft, called for the Vertical Navigation (VNAV) mode of the AFDS and the right autopilot (AP), to be engaged. During flap retraction the crew considered that the aircraft was not accelerating normally so the autopilot was disconnected and the aircraft flown manually.

The crew asked a company engineer on board the aircraft to assist them with diagnosing the airspeed problem. The right AP was re-engaged, and the QRH consulted. The crew considered that the pitch attitude and thrust were relatively normal for the stage of flight so left the AP, Auto-Throttle (AT) and Flight Directors (FD) engaged. The engineer advised the crew that the EICAS messages were displayed because the left Air Data Computer (ADC) was unserviceable; he had experienced the same defect on another company aircraft several months earlier when a bug had blocked the left pitot tube. On that occasion, the aircraft was flown without incident using the right AP until rectification could take place on the ground. In accordance with the QRH, the commander selected ALTN on the air data switch and believed that he had isolated the problem with the left ADC. He retook control of the aircraft and continued the climb with the right AP engaged using the Lateral Navigation (LNAV) and Flight Level Change (FLCH) modes.

The commander recalled selecting VNAV at about FL250. At approximately FL320, the co-pilot became aware that the aircraft's rate of climb had started to increase, and that the indicated airspeed was decreasing. He called "climb rate" and the commander attempted to select vertical speed (vs) mode and reduce the rate of climb to 1,500 ft per minute. The commander recalled that the Mode Control Panel (MCP) alternated between vs mode with a 4,000 fpm climb and altitude hold (alt hold) modes, but the aircraft's pitch attitude seemed normal. The co-pilot was now concerned with the situation and he urgently expressed concerns about the aircraft's deviations from the normal flight profile. As the AP did not appear to be following the MCP selections the co-pilot disconnected the AP and pushed forward on the control column to "increase the speed and prevent an increasing ROC (rate of climb)". He recalled calling out "I have it", but the commander had no recollection of this.

As the IAS reduced to approximately 250 kt, the commander noticed the control column move forward and he considered that a stick pusher must have activated[1]. He disconnected the AP and AT, moved the thrust levers forward, and pitched the aircraft to 3-5 degrees nose-down. Even with the AP and AT out, and the speed increasing through 245 kt, the commander could feel the control column was being pushed forward. He became aware that the co-pilot was on the controls and handed control to him while he transmitted a MAYDAY. A nearby aircraft observed from its Traffic Collision Avoidance System (TCAS) that G-STRZ's indicated level was FL310. The FD's were disengaged and the aircraft returned to Accra with the co-pilot flying. As the aircraft neared Accra, and appeared to be operating normally, the MAYDAY was downgraded to

Footnote

1 The Boeing 757 aircraft is not fitted with a stick pusher but the commander had previously flown an aircraft which had been fitted with a stick pusher

a PAN and the commander flew an uneventful approach and overweight landing.

Engineering investigation

The operator's engineers performed the engineering investigation and they found the remains of a "beetle-like creature" in the left-hand pitot system. No faults were found with the ADC, the autopilots, or any of the relevant systems.

Flight Control Computer (FCC) and FMC air data source selection

The FCCs select an air data source based on the AFDS engagement status. The FCCs use air data from the right ADC whenever the right AP is engaged in command (or first-in-command for multi-channel operation), or when only the co-pilot's FD is switched ON. Otherwise, the FCCs use air data from the left ADC. If a failure is detected on the selected ADC source, the FCCs will automatically switch to the alternate source.

In FLCH mode, the FCCs provide pitch commands to maintain the airspeed selected on the MCP. During VNAV climb operations, the FCCs provide pitch commands to maintain the speed required by the FMC.

The FMCs use data from the left ADC unless a failure has been detected, in which case the FMCs use data from the right ADC. The ADC may not determine a blockage in the pitot system to be a system failure.

Company SOPs during the takeoff roll

The company SOPs state that once the takeoff has commenced, the crew should only stop in the event of certain specific malfunctions, or if the captain decides to stop. The captain is given the additional guidance:

> '*that up to 80kts, the take-off may be rejected for any significant malfunction. At or above 80kts the take-off should be rejected only for major malfunctions.*'

There is no specific guidance in the SOPs on what to do should the ASIs disagree.

Flight Data Recording

The aircraft was fitted with a Cockpit Voice Recorder (CVR), a Flight Data Recorder (FDR) and a Quick Access Recorder (QAR). By the time the event was notified, the CVR recordings had been overwritten. The FDR and QAR contained the same data set which was used, with the assistance of the aircraft manufacturer, to provide further analysis of the event. This showed that during the initial part of the takeoff, the captain's computed indicated airspeed lagged behind ground speed. At rotation, the ADC computed airspeed was 70 kt, and the ground speed was 155 kt.

As the aircraft altitude increased, the captain's computed airspeed began to rise because the pitot pressure, trapped in the blocked pitot tube, remained constant whilst the static pressure decreased with altitude. This caused the ASI to initially under-read, then over-read at altitude.

When the aircraft climbed through 8,000 ft, the right autopilot channel was selected. This caused the FCCs to use air data from the right ADC. The AFDS FLCH mode was active during this time, and should have operated normally using air data from the right ADC. Passing 18,150 ft in the climb, his alternate air data source was selected, and the captain's computed airspeed dropped from 350 kt to 280 kt. The alternate air data source remained selected for the remainder of the flight.

As the aircraft climbed through 31,600 ft, the AFDS VNAV mode became active. Because the FMCs were using left ADC data, the they sensed an overspeed condition and provided a pitch-up command to reduce the airspeed. When the aircraft climbed through 32,500 ft, vertical speed mode became active with an initial climb rate of 4,000 fpm. Immediately afterward, the AFDS transitioned to altitude capture. The flight data recorder does not indicate the MCP selected altitude, but Boeing considered it likely that the altitude capture criteria was satisfied, which caused the AFDS to transition to altitude capture. Shortly after the transition to altitude capture, the autopilot was disconnected and the aircraft was manually pitched nose-down. The maximum rate of descent recorded was 6,919 fpm.

Previous Occurrences

In February 1996 a Boeing 757 struck the sea off the coast of the Dominican Republic about 5 minutes after take off from the Gregorio Luperon International Airport in Puerto Plata. The aircraft was destroyed and all 189 occupants were fatally injured. The report into the cause of that accident stated that:

> *'confusion of the flight crew occurred due to the erroneous indication of an increase in airspeed.'*

The erroneous airspeed indications were caused by an obstruction of the aircraft's left upper pitot tube.

In October 1996 a Boeing 757 struck the Pacific Ocean off the coast of Lima, Peru, about 30 minutes after takeoff from Jorge Chavez International Airport in Lima on a night flight to Santiago, Chile. The aircraft was destroyed and all 70 occupants were fatally injured. The flight crew had realised immediately after takeoff that their altimeters and airspeed indicators were not providing correct information and had declared an emergency, but they were unable to land the aircraft safely. The probable cause of this accident was blocked static ports.

Comment

The company have amended their engineering procedures to include the fitting of pitot covers and blanks when the aircraft is on the ground during long turnarounds.

While the previously mentioned accidents and this incident are clearly different events, they demonstrate that flying a large aircraft with unreliable instruments is demanding, and crews can become 'task saturated'. There were times during this flight where the flightcrew were confused as to what was happening. In this incident, the commander recognised a failure of his ASI before 80 kt and the takeoff could have been safely rejected. Instead, he continued the takeoff using the co-pilot's and standby ASIs and encountered a number of related emergencies. These eventually led to the declaration of a MAYDAY and return to the departure airfield. Although the commander considered that conditions were suitable for resolving the problem when airborne, a low speed rejected takeoff would have been more appropriate in these circumstances.

As a result of this incident, the company has implemented refresher training for its pilots on the AFDS, its modes, and operation. A blocked pitot tube event is also included as a part of their simulator recurrent training. The company now advise their crews to reject the takeoff if the problem is recognised at speeds below 80 kt.